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Stamp Falls Fishway Counts, Adipose Clip/CWT Recovery and Biological Sampling of Chinook Salmon Escapements in Stamp River and Robertson Creek Hatchery, 1991

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by

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ABSTRACT

Bocking, R.C. and B.L. Nass. 1992. Stamp Falls Fishway counts, adipose clip/CWT recovery and biological sampling of chinook salmon escapements in Stamp River and Robertson Creek Hatchery, 1991. Can. Manuscr. Rep. Fish. Aquat. Sci. 2172:ix + 81 p.

Estimates of salmon escapement were derived for the Stamp River for 1991 using visual counts at the Stamp Falls Fishway. After adjusting for observer error, the total escapement of chinook salmon to the Stamp River was estimated at 132261 ± 1614. Escapement estimates for coho salmon are also presented as well as partial estimates for sockeye.

The age, size, sex, and hatchery contributions for chinook salmon in the Stamp River are also described using data from carcass recovery and live returns to Robertson Creek Hatchery. The dominant age for male and female chinook salmon spawning in the river was 4 years while male and female fish returning to the hatchery were predominantly age 3 and 4, respectively. Female chinook tended to be larger than their male counterparts. Age structure analyses revealed substantial errors in the visual identification of jack chinook.

Escapement of adipose clipped chinook to the entire Stamp River system (hatchery plus upper river returns) was 4930 and represented 3.7 % of the entire population. The total hatchery contribution (marked and unmarked) to the escapement was estimated by expanding the number of observed adipose clips by the adipose mark rate at release. In 1991 Robertson Creek Hatchery contributed 84.2 % of the chinook escapement to Stamp River. The hatchery contribution estimated in this manner was compared with that estimated using the Mark Recovery Program (Kuhn 1988) method of coded wire tag expansions (78.1%). The reasons for the differences in hatchery contribution estimates using the two methods are discussed.

Key words: Stamp River, chinook, keystream, escapement, fishway, coded wire tags, hatchery contribution

RÉSUMÉ

Bocking, R.C. and B.L. Nass. 1992. Stamp Falls Fishway counts, adipose clip/CWT recovery and biological sampling of chinook salmon escapements in Stamp River and Robertson Creek Hatchery, 1991. Can. Manuscr. Rep. Fish Aquat. Sci. 2172:ix + 81 p.

Les échappées de saumon de 1991 dans la rivière Stamp ont été estimées à partir des dénombrements visuels effectués à la passe migratoire de Stamp Falls. Après correction des erreurs d'observation, l'échappée totale du saumon quinnat de la rivière a été estimée à 132 261 ± 1 614 poissons. Les auteurs présentent aussi les valeurs estimées pour le saumon coho ainsi que des estimations partielles pour le saumon rouge.

L'âge, la taille, le sexe et l'apport en poissons de pisciculture sont aussi présentés pour le saumon quinnat de la rivière Stamp. Ces valeurs ont été calculées à partir des données de la récupération des carcasses et de la remontée à la pisciculture de Robertson Creek. Les saumons quinnats mâles et femelles qui ont frayé dans la rivière étaient surtout âgés de quatre ans tandis que les mâles et les femelles qui sont revenue à la pisciculture étaient âgés de, respectivement, trois et quatre ans. Les femelles des quinnats avaient tendance à âtre plus grosses que les mâles. Des analyses de la structure des âges ont montré que l'identificatin visuelle des jeunes quinnats mâles présentait des erreurs appréciables.

L'échappée de saumons quinnats à nageoire adipeuse rognée dans l'ensemble du bassin de la rivière Stamp (remontées à la pisciculture et dans les parties d'amont) s'est élevée à 4 930 poissons, ce qui correspond à 3.7% de l'ensemble de la population. L'apport total des poissons de pisciculture (marqués et non marqués) à l'échappée a été estimé en appliquant au nombre de poissons à adipeuse rognée observés le taux de marquage des poissons remis à l'eau. En 1991, la remontée de quinnats de la rivière Stamp était constituée à 84.2% de poissons provenant de la pisciculture de Robertson Creek. L'apport de la pisciculture estimé de cette façon est comparé à celui estimé par la méthode du programme de récupération des étiquettes (Kuhn, 1988) fondée sur les fils codés, qui est de 78.1%. Les auteurs traitent des écarts entre les résultats des deux méthodes d'estimtion des apports piscicoles.

Mots clés: rivière Stamp, quinnat, cours d'eau clé, passe migratoire, fils codés, apport de pisciculture

INTRODUCTION

The chinook salmon of the Somass River system was selected as one of the indicator stocks for assessing the response of Pacific chinook salmon stocks to a new harvest management regime. The goal of the new management regime is to rebuild chinook stocks to historical levels. This "key stream" program began in 1984 in response to objectives set out in the Canada - U.S. Salmon treaty.

The major objectives of the key stream program are:

1. to accurately estimate chinook escapement on key streams;

2. to estimate harvest rates and contributions to fisheries and escapement based on coded wire tagged/adipose clip returns, including estimates of the total escapement of coded wire tags to the key streams system; and

3. to estimate the contribution of hatchery and natural production to the escapement.

This report deals with the determination of spawning escapement to the Stamp River in 1991 and related biological information. The objectives of the study were:

1. to estimate the total chinook escapement to the Stamp River;

2. to determine the age and sex composition of the in-river population and hatchery returns to the system; and

3. to estimate the total escapement of coded wire tagged chinook to the system, thereby assessing the hatchery contribution to the total escapement.

Part I of this report addresses the first objective and Part II of the report addresses objectives 2 and 3. Escapement estimates for the Stamp River for 1991 were derived using visual counts at the Stamp Falls Fishway and brailer counts at Robertson Creek Hatchery. Coded wire and adipose clip returns and hatchery contributions were estimated using dead recoveries of chinook throughout the Stamp River and live returns of chinook to Robertson Creek Hatchery.

PART I: STAMP FALLS FISHWAY COUNTS

INTRODUCTION

The chinook salmon of the Somass River system (including Robertson Creek Hatchery production) are the most abundant stock of this species on Vancouver Island and make important contributions to troll, net and sport fisheries in U.S. and Canadian waters. Coded wire tag returns for chinook released from Robertson Creek Hatchery have been used to estimate the contribution of hatchery production to coastal fisheries (Sibert and Schnute 1982; English and Griffiths 1984); however, these analyses were incomplete due to the lack of reliable data on escapement, Indian fishery catches, and terminal sport fishery harvests. In 1984, the Department of Fisheries and Oceans initiated several investigations for Somass River chinook, including:

1. escapement estimation using a combination of mark-recapture techniques, counts of fish passing through the Stamp Falls Fishway, deadpitch surveys and hatchery returns (Lightly et al. 1988);

2. catch estimates for the Indian food fishery from field surveys; and

3. catch estimates for the Alberni Inlet and Somass River sport fisheries derived from creel surveys.

In 1985, the responsibility for providing reliable escapement and estimates for Somass River chinook was allocated to the Key Stream Program as part of a coast-wide attempt to monitor the effect of new management action on chinook stock status. After a number of years of attempting various methods, the salmon run to the Stamp River was successfully monitored in 1989 using visual counts. The 1991 program was executed using the same methods as in 1990. Our specific objectives in the 1991 study were to:

1. count all chinook, coho, sockeye, steelhead, and other salmonids passing through the Stamp Falls Fishway between 7 September and 20 November, 1991;

2. quantify the random error associated with species identification and mis-counting of fish migrating through the fishway; and

3. to estimate the number of fish migrating through the fishway during periods when reliable counting could not be conducted.

STUDY AREA

The Somass River system is one of the largest on Vancouver Island and includes the Stamp and Sproat Rivers near Port Alberni (Fig. 1). The Stamp River drains Great Central Lake and flows northeast and southeast into the Somass River. The Sproat River drains Sproat Lake and flows eastward into the Stamp River.

The Somass River system supports sockeye, chinook, coho, chum and pink salmon, as well as steelhead and cutthroat trout. It supports the largest chinook salmon stock on the west coast of Vancouver Island. The Somass River chinook stocks are comprised of wild populations spawning in the Sproat and Stamp Rivers and production from Robertson Creek Hatchery (Fig. 1). Somass River chinook generally have a fall run timing with the majority of the population returning in September and October. The majority of the chinook return as four-year-olds, although ages range from 2 to 7 years. Coho salmon appear to have a similar run timing (Wright, 1990).

Sockeye returning to the Somass River system are from Sproat and Great Central lakes and tributaries. Only a fraction of the sockeye returning to Great Central Lake are enumerated at Stamp Falls Fishway since the majority of the run (> 85%) has usually passed prior to 1 September. Sockeye have not been rigorously counted at Stamp Falls since the counting systems employed have usually allowed small adults and jacks (< 45 cm) to pass through the counting bars undetected. Coho, pink, chum, and steelhead salmon have also been enumerated at Stamp Falls Fishway with varying levels of rigor and success in recent years.

METHODS

Biophysical Observations

Water temperatures were recorded daily at the fishway, usually between the hours of 0800 and 1000 am using a hand held thermometer. Water levels were also recorded daily using a staff gauge positioned on the upstream corner of the fishway in the exit pool. Levels were recorded to the nearest 1.0 cm. Weather conditions were also monitored in terms of percent sun, cloud, and precipitation.

Fishway Counts

Visual counts of salmonids passing through the Stamp Falls Fishway were made between 7 September and 10 November, 1991. A counting station was installed at the upstream end of the

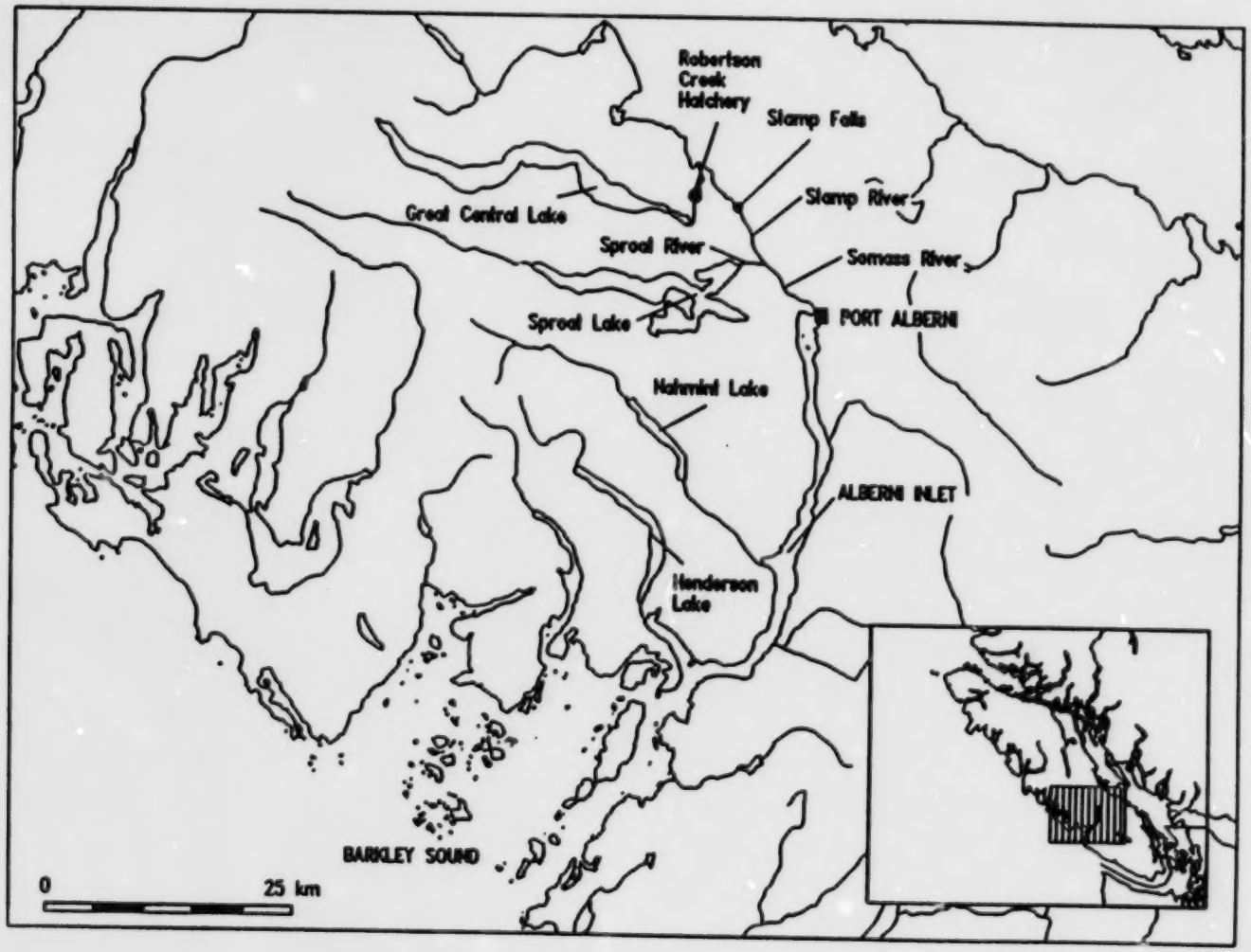

Figure 1. Map of Somass River system and Stamp Falls.

fishway and is shown diagrammatically in Figure 2. Aluminum panels, 2.4 m x 1 m, with bars spaced 5.1 cm apart, were placed in the fishway. The panels were stacked one on top of the other as needed for the top of the panels to be at least .3 m above the water line. The panels were constructed of 7.6 cm channel aluminum frame with 2.54 cm (od) aluminum conduit. A white vexar fence (mesh size = 2 in), strung on an aluminum frame was placed on the upstream side of the panel to effectively close the gap between the bars and prevent small salmonids (i.e. sockeye and coho < 45 cm) from escaping between the panel bars. The panels were set into channel aluminum tracks which were attached to the inside of the fishway. Large aluminum gates, situated immediately downstream of the panels were positioned in a VEE formation to funnel fish through an opening at the bottom of the lower most panel.

Fish then passed over a 2 m x 2.4 m wide aluminum flashboard. The opening was 0.3 m high and 1.3 m wide, and was designed to prevent multi-layered schools of fish from entering. A gate could be closed to prevent passage when the counting station was unmanned. To improve visibility a 1 m x 1 m viewing window was floated on the surface over the flashboard. Observers sat on top of the fishway and counted the fish as they passed under the viewing window. A thin film of water was placed on top of the viewing window to enhance the image of the fish below. To prevent glare, tarps were placed over the fishway at the counting site.

Counts were made daily between dawn and dusk (usually from 0800 to 1700) and the panel gate was closed during the night. Two observers manned the station during counting hours and alternated counting every 1 hour. The counting system described above worked well under most flow conditions.

Total counts of adult and jack chinook, adult and jack coho, sockeye, pink, chum, and steelhead were recorded hourly. The aluminum flashboard was marked at 34 cm and 59 cm to allow size range estimates of coho and chinook jacks, respectively. These total length size categories are based on age-length data from Robertson Creek Hatchery. Daily summaries presenting totals for each of the salmonid species (chinook adults, chinook jacks, coho adults, coho jacks, sockeye and steelhead) counted at Stamp Falls Fishway were faxed to Robertson Creek Hatchery twice weekly and used for inseason management at the hatchery.

Precision of Counts

Estimates of counting and species identification errors were derived from a program of sub-sampling. For approximately one hour each day, the exit from the fishway was blocked using aluminum panels covered with vexar mesh (2 cm) so that fish could be counted, trapped and examined for species verification. Fish were counted through the gate and over the flashboard as normal but were contained in a 2 m x 2.4 m area. Between 10 and 30 fish of varying species composition were usually counted for each test. The captured fish were then dipnetted from the containment area and carefully checked for species. The tests were conducted at various times of the day and under varying light and water conditions. Tests were conducted daily from September 8 to October 26. No tests were conducted after this date because of the low number of fish passing through the fishway each hour.

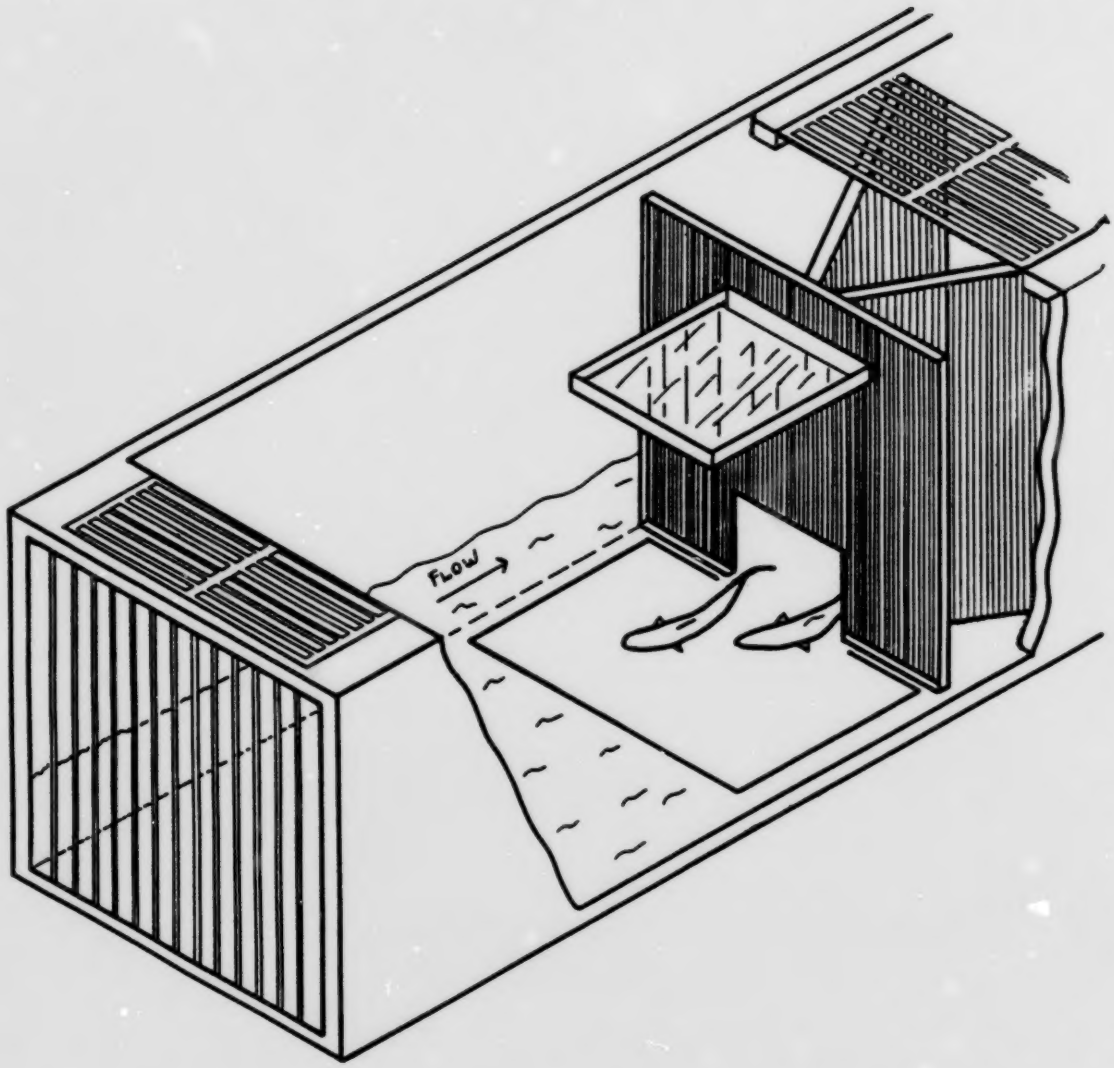

Figure 2. Diagram of the fish counting facility installed at the upstream end of Stamp Falls Fishway, 7 Sept - 10 Nov, 1991.

Hourly visual counts and species identification were adjusted in proportion to the difference between the observed visual counts and the true or verified counts. These differences were calculated in terms of the mean proportional error (PE) for each sampling interval (generally 1 week):

$$PE_k = \frac{\sum_{j=1}^{n} \frac{VerC_j}{VC_j}}{n} \quad (1)$$

where $VerC_j$ is the true number of fish determined from each test (j), VC_j is the number of fish observed during the test, PE_k is the mean proportional error of the visual counts for sample period k (usually 1 week), and n is the number of tests conducted in each sampling interval.

The hourly counts of each species could then be adjusted using the following equation:

$$VC_{k,j,i} = VC_{k,j,i} \cdot PE_k \quad (2)$$

where $VC_{k,j,i}$ is the actual count of fish in hour i, on day j and in sample period k; $VC'_{k,j,i}$ is the corresponding adjusted count; and PE_k is the mean proportional error for sample period k.

The variance can be calculated for the total number of fish estimated in each week using the following equation:

$$Var(VC_k) = \sum_{i=1}^{m} \sum_{j=1}^{n} (VC_{k,j,i})^2 \cdot Var(PE_k) \quad (3)$$

where VC_k is the total weekly count, VC'_k is the adjusted weekly count and $Var(PE_k)$ is the variance estimated from each sample period series of comparisons of trap counts with visual counts (from equation 1).

The adjusted hourly counts for each species were summed to give daily estimates of the number of fish moving through the fishway and further summed to provide a total population estimate. The weekly variance estimates were summed to produce a single variance estimate and 95% confidence intervals ($\pm t_{0.05}$ SE) for the escapement of each species counted through the Stamp Falls Fishway. The standard error estimate was obtained by taking the square root of the above variance, divided by the total number of verification tests (n=45). In addition, the verification tests were used to compare the counting accuracy of each of the three observers used in the study.

Interpolation of Missing Counts

An unknown number of fish migrating prior to September 7 could not be estimated in any rigorous manner. However, we were able to obtain a complete count for the period 7 September to 10 November.

RESULTS

Accuracy and Precision of Counts

Two factors were considered in assessing the accuracy and precision of the fishway counts. The first involved observer error in enumerating the fish and in species identification. The second involved a comparison of "between observer" error. To assess these sources of error, verification tests were conducted for approximately 1 hour each day. We attempted to conduct the tests at various times of the day to account for varying light conditions and diel migration patterns of the fish. Figure 3 shows the hourly distribution of tests conducted for each of three timing periods.

Species Identification and Enumeration Error

Species identification error was determined by comparing the visual counts made during the verification tests with the true number and species composition of fish captured during the tests (Table 1). Scattergrams of the daily visual counts and the verified counts were plotted for each of chinook adults, chinook jacks, coho adults, coho jacks, and sockeye (Fig. 4). Not enough data was collected to permit an evaluation of counting error for steelhead, pink or chum. Standard regression analyses were performed on the data in these plots to test for the form (linear or nonlinear) of the relationship between the actual visual counts and the true number of fish. In all cases, standard residual analyses did not allow the rejection of linearity in the relations for each species. Also, each of the y-intercepts approximated zero. We, therefore, used simple ratio estimators to derive weekly correction factors and variance estimates for our counts of each species (Table 1).

The verification tests reveal the following results. The amount of bias in the visual counts, depending on the species, was between -24% and +7% during the first week of tests. The amount of error fluctuated between -17% and +15% for the next 2 weeks and by the last week of October the error was only between -8% and +4%, depending on the species enumerated. Counts of adult chinook were the most accurate, followed closely by sockeye. Counts of jack chinook and coho were the least accurate. The precision of the visual counts was also poor during the first 3 weeks of counting ($0.05 < SD < 0.50$) but precision improved substantially thereafter, particularly for chinook. From the second week of October onwards, the standard deviation on adult counts of chinook was between 0.0 and 0.38. The precision of coho adult and jack counts was poorest. These differences in the precision of the counts for each species are graphically portrayed in Figure 4.

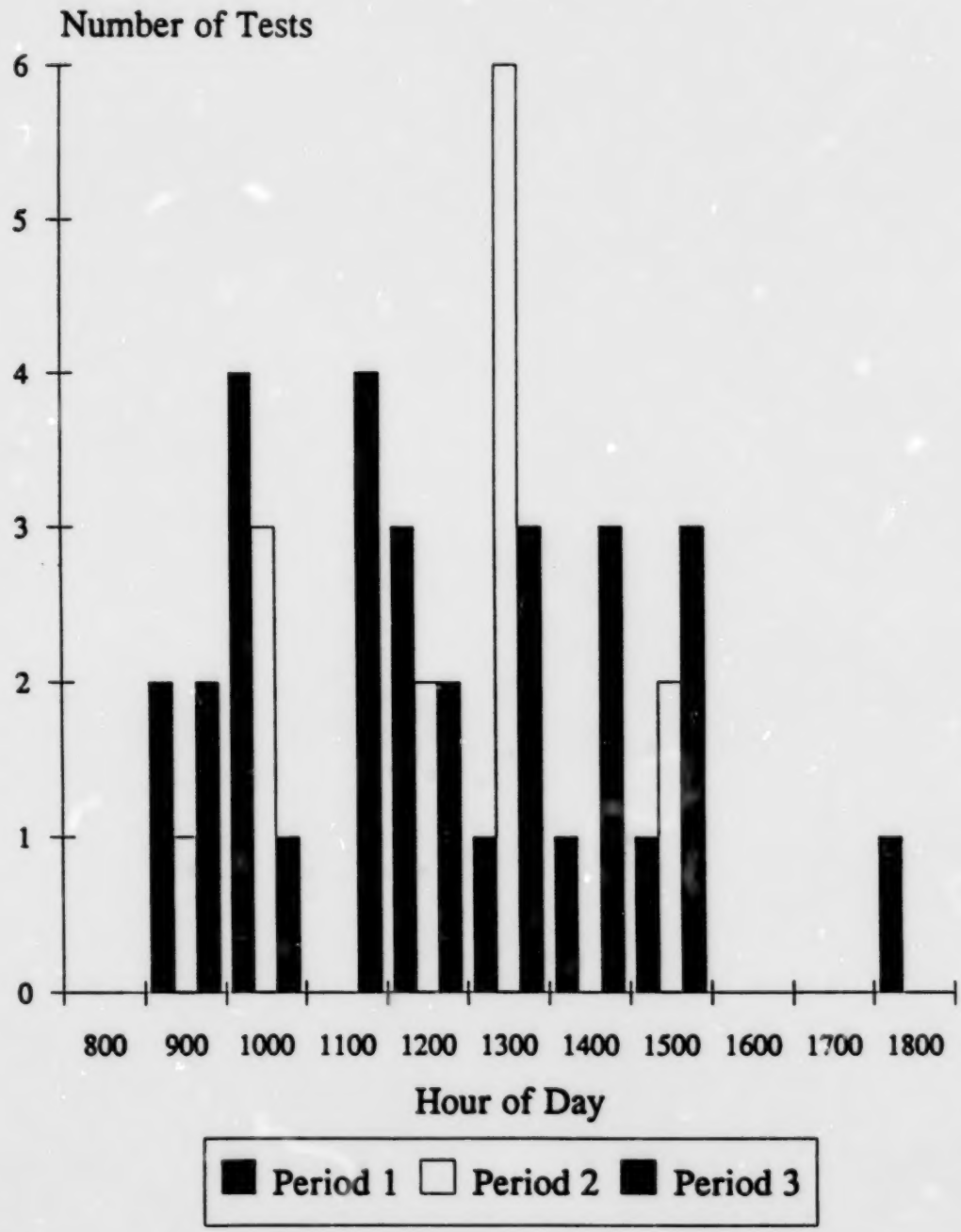

Figure 3. Frequency distribution of verification tests conducted at Stamp Falls. Period 1 = 11 Sept to 24 Sept, Period 2 = 25 Sept to 18 Oct, and Period 3 = 19 Oct to 23 Oct.

Table 1. Results of Stamp Falls verification tests, 1991. O = observed count, V=verified count.

Week	Date	Time	Observer	Gauge height	Chinook adults			Chinook jacks			Coho adults			Coho jacks			Sockeye		
					O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O
1	8/9/91	1800	rob	1.22	1.00	1.00	1.00	3.00	1.00	0.33	2.00	2.00	1.00	0.00	0.00	1.00	10.00	10.00	1.00
1	9/9/91	1000	rob	1.19	7.00	7.00	1.00	3.00	3.00	1.00	2.00	3.00	1.50	0.00	0.00	1.00	5.00	5.00	1.00
1	10/9/91	1200	gary	1.13	3.00	3.00	1.00	0.00	2.00	0.00	8.00	8.00	1.00	4.00	4.00	1.00	1.00	1.00	1.00
1	11/9/91	1000	rob	1.09	5.00	5.00	1.00	4.00	4.00	1.00	2.00	2.00	1.00	2.00	1.00	0.50	5.00	5.00	1.00
1	12/9/91	1200	gary	1.07	15.00	15.00	1.00	4.00	4.00	1.00	6.00	6.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00
1	13/9/91	1400	gary	1.07	6.00	6.00	1.00	2.00	2.00	1.00	5.00	5.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
1	14/9/91	1300	doug	1.07	4.00	3.00	0.75	0.00	0.00	1.00	12.00	12.00	1.00	2.00	2.00	1.00	4.00	6.00	1.50
			Mean				**0.96**			**0.76**			**1.07**			**0.93**			**1.07**
			SD				**0.09**			**0.42**			**0.19**			**0.19**			**0.19**
2	15/9/91	1000	gary	1.06	5.00	7.00	1.40	6.00	9.00	1.50	8.00	8.00	1.00	1.00	1.00	1.00	3.00	6.00	2.00
2	16/9/91	900	doug	1.06	2.00	2.00	1.00	2.00	2.00	1.00	6.00	6.00	1.00	1.00	1.00	1.00	10.00	9.00	0.90
2	17/9/91		no test	1.15															
2	18/9/91	1000	rob	1.11	4.00	4.00	1.00	3.00	3.00	1.00	8.00	8.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	19/9/91	1500	doug	1.09	2.00	2.00	1.00	4.00	4.00	1.00	8.00	9.00	1.13	4.00	4.00	1.00	2.00	2.00	1.00
2	20/9/91	1200	rob	1.04	5.00	5.00	1.00	0.00	0.00	1.00	4.00	4.00	1.00	3.00	0.00	0.00	1.00	1.00	1.00
2	21/9/91	900	gary	1.06	2.00	2.00	1.00	1.00	1.00	1.00	10.00	10.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00
			Mean				**1.07**			**1.08**			**1.02**			**0.83**			**1.15**
			SD				**0.16**			**0.20**			**0.05**			**0.41**			**0.42**
3	22/9/91	1000	rob	1.05	0.00	0.00	1.00	1.00	1.00	1.00	12.00	12.00	1.00	3.00	2.00	0.67	2.00	2.00	1.00
3	23/9/91	1000	gary	1.11	4.00	4.00	1.00	1.00	1.00	1.00	10.00	11.00	1.10	3.00	5.00	1.67	0.00	0.00	1.00
3	24/9/91	1200	doug	1.04	12.00	10.00	0.83	1.00	0.00	0.00	4.00	7.00	1.75	1.00	1.00	1.00	1.00	1.00	1.00
3	25/9/91	1200	gary	0.96	6.00	4.00	0.67	3.00	3.00	1.00	6.00	8.00	1.33	1.00	1.00	1.00	0.00	0.00	1.00
3	26/9/91	1500	doug	0.94	3.00	3.00	1.00	0.00	1.00	1.00	14.00	14.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00
3	27/9/91	1300	rob	0.99	3.00	3.00	1.00	2.00	2.00	1.00	7.00	7.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00
3	28/9/91	900	doug	0.99	4.00	3.00	0.75	1.00	1.00	1.00	7.00	6.00	0.86	3.00	3.00	1.00	3.00	5.00	1.67
			Mean				**0.89**			**0.86**			**1.15**			**0.90**			**1.10**
			SD				**0.14**			**0.38**			**0.30**			**0.50**			**0.25**

Table 1. Results of Stamp Falls verification tests, 1991. O = observed count, V=verified count.

Week	Date	Time	Observer	Gauge height	Chinook adults			Chinook jacks			Coho adults			Coho jacks			Sockeye		
					O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O
4	29/9/91	1000	rob	1.00	5.00	4.00	0.80	1.00	1.00	1.00	4.00	4.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
4	30/9/91	1500	gary	1.09	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	0.50	6.00	6.00	1.00
4	1/10/91	1300	rob	1.09	12.00	12.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
4	2/10/91	1300	gary	1.09	9.00	10.00	1.11	2.00	2.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00
4	3/10/91	1300	mike	1.08	23.00	22.00	0.96	3.00	4.00	1.00	4.00	4.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00
4	4/10/91	1300	gary	1.08	10.00	9.00	0.90	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	0.00	0.00	1.00
4	5/10/91	1300	mike	1.06	21.00	19.00	0.90	2.00	2.00	1.00	2.00	5.00	2.50	2.00	2.00	1.00	0.00	0.00	1.00
			Mean				**0.95**			**1.00**			**1.36**			**0.93**			**1.00**
			SD				**0.10**			**0.00**			**0.63**			**0.19**			**0.00**
5	6/10/91	1400	rob	1.06	9.00	9.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	7/10/91		no test	1.06															
5	8/10/91		no test	1.04															
5	9/10/91	1100	gary	1.04	13.00	13.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
5	10/10/91	1500	rob	1.04	20.00	21.00	1.05	0.00	1.00	1.00	3.00	2.00	0.67	0.00	0.00	1.00	1.00	1.00	1.00
5	11/10/91	900	gary	1.02	6.00	6.00	1.00	3.00	3.00	1.00	3.00	3.00	1.00	3.00	4.00	1.33	0.00	0.00	1.00
5	12/10/91	1100	mike	1.02	14.00	12.00	0.86	2.00	2.00	1.00	3.00	4.00	1.33	1.00	1.00	1.00	0.00	0.00	1.00
			Mean				**0.98**			**1.00**			**1.00**			**1.07**			**1.00**
			SD				**0.07**			**0.00**			**0.24**			**0.15**			**0.00**
6	13/10/91	900	gary	1.02	8.00	8.00	1.00	0.00	0.00	1.00	4.00	4.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
6	14/10/91	1500	mike	1.02	11.00	11.00	1.00	1.00	0.00	0.00	3.00	3.00	1.00	1.00	2.00	2.00	0.00	0.00	1.00
6	15/10/91	1500	rob	1.01	6.00	5.00	0.83	3.00	3.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	2.00	1.00	0.50
6	16/10/91	1100	mike	1.03	11.00	11.00	1.00	2.00	2.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00
6	17/10/91	1200	rob	1.02	17.00	17.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
6	18/10/91	1100	gary	1.01	12.00	12.00	1.00	3.00	3.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
6	19/10/91	1000	rob	1.07	15.00	14.00	0.93	3.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00
			Mean				**0.97**			**0.86**			**0.86**			**1.14**			**0.93**
			SD				**0.06**			**0.38**			**0.38**			**0.38**			**0.19**

Table 1. Results of Stamp Falls verification tests, 1991. O = observed count, V = verified count.

Week	Date	Time	Observer	Gauge height	Chinook adults			Chinook jacks			Coho adults			Coho jacks			Sockeye		
					O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O	O	V	V/O
7	20/10/91	1400	gary	1.07	14.00	14.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
7	21/10/91	1300	mike	1.07	10.00	10.00	1.00	2.00	2.00	1.00	4.00	5.00	1.25	1.00	1.00	1.00	2.00	1.00	0.50
7	22/10/91	1300	gary	1.07	8.00	6.00	0.75	1.00	1.00	1.00	2.00	3.00	1.00	0.00	0.00	1.00	0.00	0.00	1.00
7	23/10/91	1300	mike	1.11	10.00	9.00	0.90	2.00	2.00	1.00	2.00	2.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00
7	24/10/91	1400	rob	1.10	7.00	7.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	2.00	2.00	1.00
7	25/10/91	1200	mike	1.08	5.00	5.00	1.00	1.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00
7	26/10/91	(no test)		1.06															
			Mean				**0.94**			**1.00**			**1.04**			**1.00**			**0.92**
			SD				**0.10**			**0.00**			**0.10**			**0.00**			**0.20**

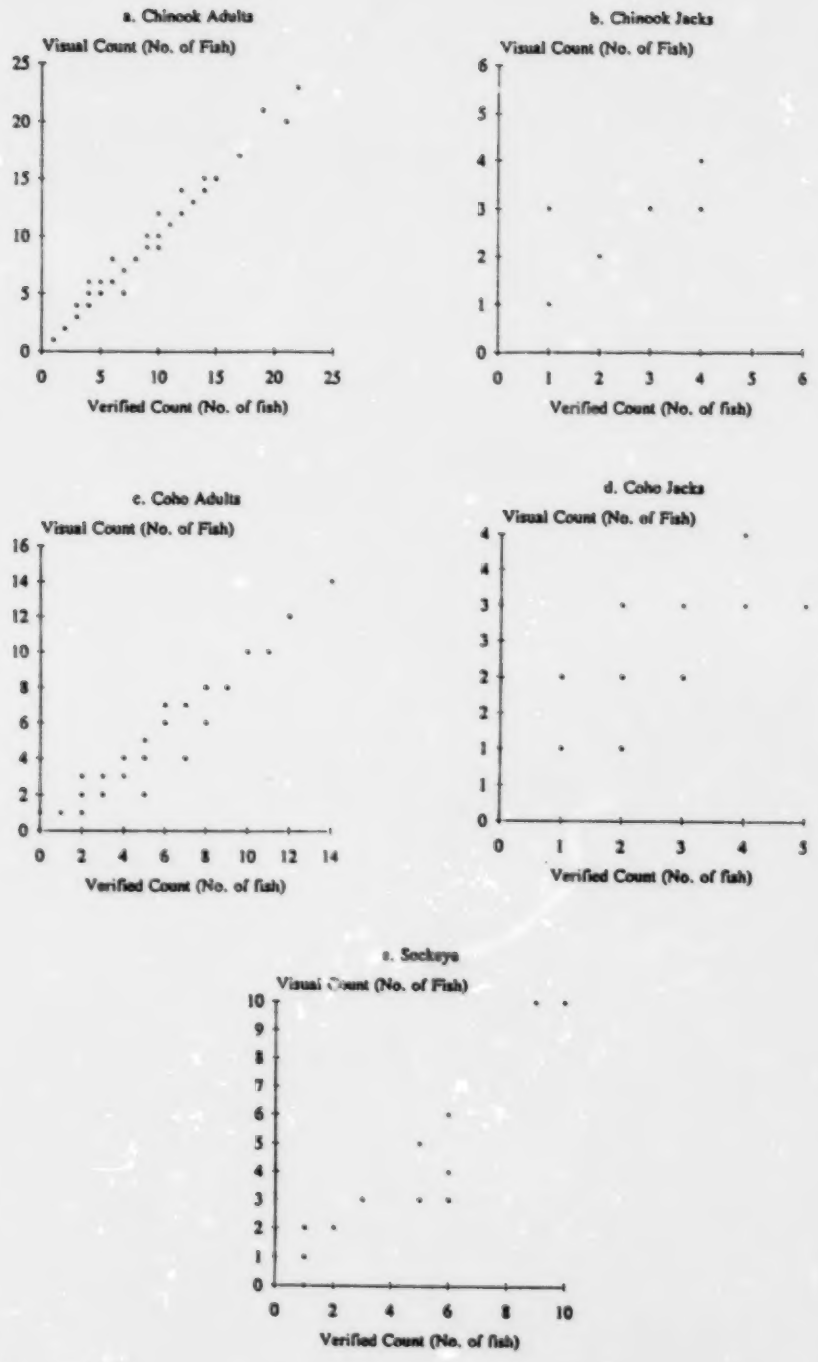
a. Chinook Adults
Visual Count (No. of Fish)
Verified Count (No. of fish)
b. Chinook Jacks
Visual Count (No. of Fish)
Verified Count (No. of fish)
c. Coho Adults
Visual Count (No. of Fish)
Verified Count (No. of fish)
d. Coho Jacks
Visual Count (No. of Fish)
Verified Count (No. of fish)
e. Sockeye
Visual Count (No. of Fish)
Verified Count (No. of fish)

Figure 4. Scattergrams of visual counts versus verified counts from all verification tests conducted at Stamp Falls.

Between Observer Error

The average observer error was calculated for each of the three observers using the data from the verification tests (Table 2). No significant differences were found between observers for any of the species (t-test, $p > 0.05$). There was, however, a tendency on the part of all observers to over count the number of coho and sockeye although in all cases the mean observer error was not significantly different from 1.0 (x^2, $p > 0.05$).

Incomplete Counts

During the counting program, there was no time when fish could pass through the fishway without being counted. The only other time when fish may have moved undetected was prior to 7 September or after 10 November.

Adjusted Counts and Population Estimates

The daily fishway counts for each species, adjusted for observer error are shown in Table 3. The unadjusted hourly counts are provided in Appendix 1-1 to 1-5. The total estimated number of adult chinook passing through the fishway between 7 September and 10 November was 114416 $\pm$ 1162. The estimate of jack chinook was 17845 $\pm$ 452. Adult coho numbered 37947 $\pm$ 1453 while jack coho numbered 7570 $\pm$ 455. We estimated a total of 12344 $\pm$ 258 sockeye passed through the fishway during the counting period.

Migration Timing

Seasonal Migration

Figure 5 shows the adjusted daily counts of chinook adults and jacks at the Stamp Falls Fishway along with temperature and water levels. The migration of chinook adults peaked at 7187 fish on 7 October. The adjusted counts of chinook jacks peaked several times with the daily maximum of 880 occurring on 2 October. Migration timing of chinook seemed to occur irrespective of water levels. Figure 5 also indicates that the counting period from 7 September to 10 November covered most of the migration of chinook with some of the front end of the migration missed. Over 1086 adult chinook were counted on the second day of counting and as many as 2000 to 5000 chinook may have passed through the fishway prior to this date. By 10 November, counts of adult chinook were less than 100 per day and the run of chinook was all but over.

Table 2. Comparison of observer error from verification tests.

Observer	Number of tests	Chinook Adults		Chinook Jacks		Coho Adults		Coho Jacks		Sockeye	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	6	0.89	0.13	0.83	0.41	1.12	0.32	0.83	0.41	1.18	0.32
2	16	0.99	0.15	0.97	0.29	1.09	0.26	1.03	0.23	1.06	0.25
3	8	0.95	0.06	0.88	0.35	1.14	0.68	1.13	0.35	0.94	0.18
4	15	0.97	0.07	0.96	0.17	1.01	0.16	0.88	0.28	0.97	0.13

Table 3. Total daily counts and 95% confidence limits for salmonids passing through Stamp Falls fishway, September 7 to November 10, 1991. These counts are adjusted for species verification (Table 1).

Date	Chinook		Coho		Sockeye	Chum	Steelhead
	Adults	Jacks	Adults	Jacks			
Sep-07	88	24	46	3	224	0	2
Sep-08	1086	204	371	86	983	0	2
Sep-09	1964	398	332	73	1432	0	0
Sep-10	1513	474	398	96	1101	0	1
Sep-11	2318	548	341	146	686	0	6
Sep-12	2164	402	434	152	553	0	4
Sep-13	1692	167	625	126	287	0	4
Sep-14	1072	176	687	124	311	3	3
Sep-15	2036	471	743	126	577	0	7
Sep-16	1926	578	792	274	522	0	15
Sep-17	1681	517	891	339	423	0	9
Sep-18	1529	432	781	330	250	0	7
Sep-19	1542	445	430	252	196	0	8
Sep-20	1697	447	489	220	104	0	15
Sep-21	1514	384	990	215	53	0	9
Sep-22	1403	444	2389	346	112	0	22
Sep-23	1061	329	1722	278	155	0	7
Sep-24	1428	395	2101	240	226	0	4
Sep-25	1768	458	2077	406	301	0	9
Sep-26	1545	529	2289	479	415	0	11
Sep-27	1184	418	1733	328	392	0	3
Sep-28	1262	324	2163	248	355	0	2
Sep-29	1194	360	1473	174	297	0	8
Sep-30	1400	352	745	187	328	0	8
Oct-01	2504	763	1068	193	549	0	10
Oct-02	3461	880	839	119	247	0	7
Oct-03	2664	670	714	137	98	0	12
Oct-04	3280	422	850	112	70	0	6
Oct-05	2785	467	839	138	81	0	3
Oct-06	4883	406	924	165	59	0	2
Oct-07	7187	439	812	101	36	0	1
Oct-08	5775	393	942	97	27	0	9
Oct-09	4274	339	849	135	36	0	9
Oct-10	3359	283	673	137	28	0	7
Oct-11	3230	340	593	157	28	0	4
Oct-12	2726	325	482	120	44	0	8
Oct-13	2934	236	311	73	14	0	1
Oct-14	3023	241	224	66	16	0	5
Oct-15	2377	229	151	76	14	1	2
Oct-16	2477	218	190	63	47	0	9
Oct-17	2995	187	400	64	8	0	10
Oct-18	3564	197	247	42	25	2	9
Oct-19	2940	255	156	41	62	0	13
Oct-20	2094	203	176	37	59	1	13

Table 3. Total daily counts and 95% confidence limits for salmonids passing through Stamp Falls fishway, September 7 to November 10, 1991. These counts are adjusted for species verification (Table 1).

	Chinook		Coho				
Date	Adults	Jacks	Adults	Jacks	Sockeye	Chum	Steelhead
Oct-21	1726	219	157	32	46	2	10
Oct-22	1405	123	99	16	29	7	6
Oct-23	1445	124	126	20	25	3	8
Oct-24	1038	97	75	22	22	1	4
Oct-25	771	63	93	14	6	1	5
Oct-26	538	47	60	10	0	2	4
Oct-27	373	44	46	10	0	0	0
Oct-28	325	11	32	5	0	1	4
Oct-29	242	12	18	6	0	2	2
Oct-30	205	28	22	4	2	0	1
Oct-31	189	30	29	3	0	0	2
Nov-01	304	38	35	8	9	2	6
Nov-02	199	31	27	6	2	0	3
Nov-03	71	14	6	2	3	1	0
Nov-04	257	36	31	6	22	3	1
Nov-05	206	30	74	9	85	9	8
Nov-06	89	19	74	8	17	4	6
Nov-07	61	5	20	8	18	0	3
Nov-08	243	64	191	26	124	11	9
Nov-09	100	29	183	27	85	4	4
Nov-10	28	10	69	9	19	2	4
Total	**114416**	**17845**	**37947**	**7570**	**12344**	**62**	**396**
SE	578.30	225.19	723.15	226.06	128.52		
Upper 95% CL	115578	18297	39400	8025	12602		
Lower 95% CL	113254	17392	36493	7116	12086		

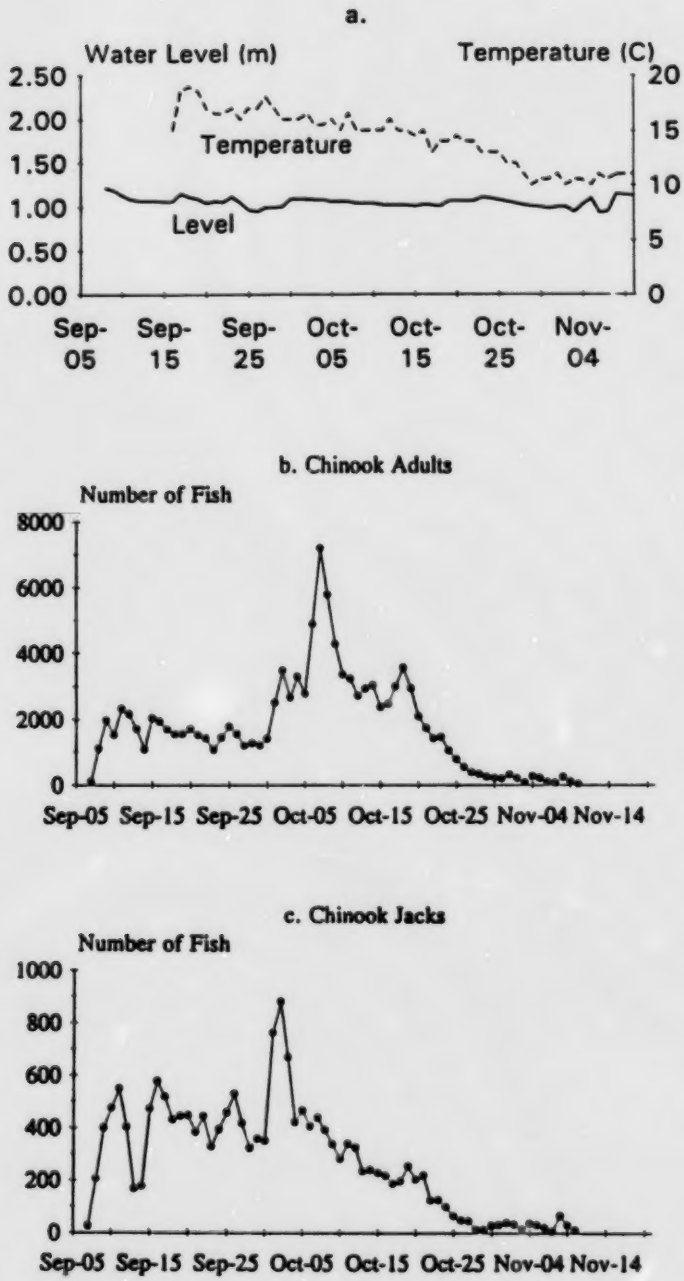

Figure 5. Daily water levels and temperatures at Stamp Falls (a). Adjusted daily counts of adult and jack chinook at Stamp Falls (b and c).

Coho adults followed a similar migration pattern as for adult chinook (Fig. 6) with peak numbers of over 2000 a day occurring during the last week of September. The adjusted counts of jack coho peaked around the same time. The counting period of 7 September to 10 November appeared to have covered most of the adult coho run through the fishway but some of the early run (prior to 7 September) coho may have been missed. Coho migration also appeared to be independent of water levels.

Counts of sockeye salmon at Stamp Falls had a shorter duration with a maximum daily count of 1432 on 9 September. By the end of September, the sockeye run had tailed off dramatically (Fig. 7).

Adult chinook that were tagged during the second week of September took, on average, 39.3 days to reach the hatchery brailers and 43.0 days before they were recovered in the dead pitch (Table 4). Chinook tagged during the third week of October took 10 days to reach the hatchery brailers and 14.7 days to the dead pitch.

It should be noted that the count of sockeye at Stamp Falls Fishway does not represent the total escapement of sockeye to Great Central Lake as the majority of sockeye migrate prior to the commencement of counting. However, counts at the fishway can be used as a check against sockeye counts at the outlet to Great Central Lake from 7 September to 10 November.

Diel Migration

To ensure complete counts of salmonids passing through the fishway, the gate to the counting facility was closed and fish migration was blocked from 1800 to 0800 hours. Hourly counts of each species were made during daylight hours. The mean hourly count of each species for four different counting periods were calculated and plotted in Figures 8, 9 and 10. Hourly counts during times when verification tests were conducted were excluded from the analysis.

There was no obvious pattern of diel migration for chinook (Fig. 8). It would appear, however, that the movement of chinook through the fishway tended to start out slowly for the first hour after the gate was opened in the morning and decrease again during the last hour of counting. Coho and sockeye movements were strongest in the early morning (0800-1000) and then decreased throughout the day (Figs. 9 and 10).

DISCUSSION

Salmonids migrating through the Stamp Falls Fishway were visually enumerated at the upstream end of the fishway. The objectives of the program were to: 1) obtain highly accurate counts of all species of fish passing through the fishway with an emphasis on the number of chinook adults and jacks; and 2) quantify the errors associated with counting, speciation, and the ability of observers

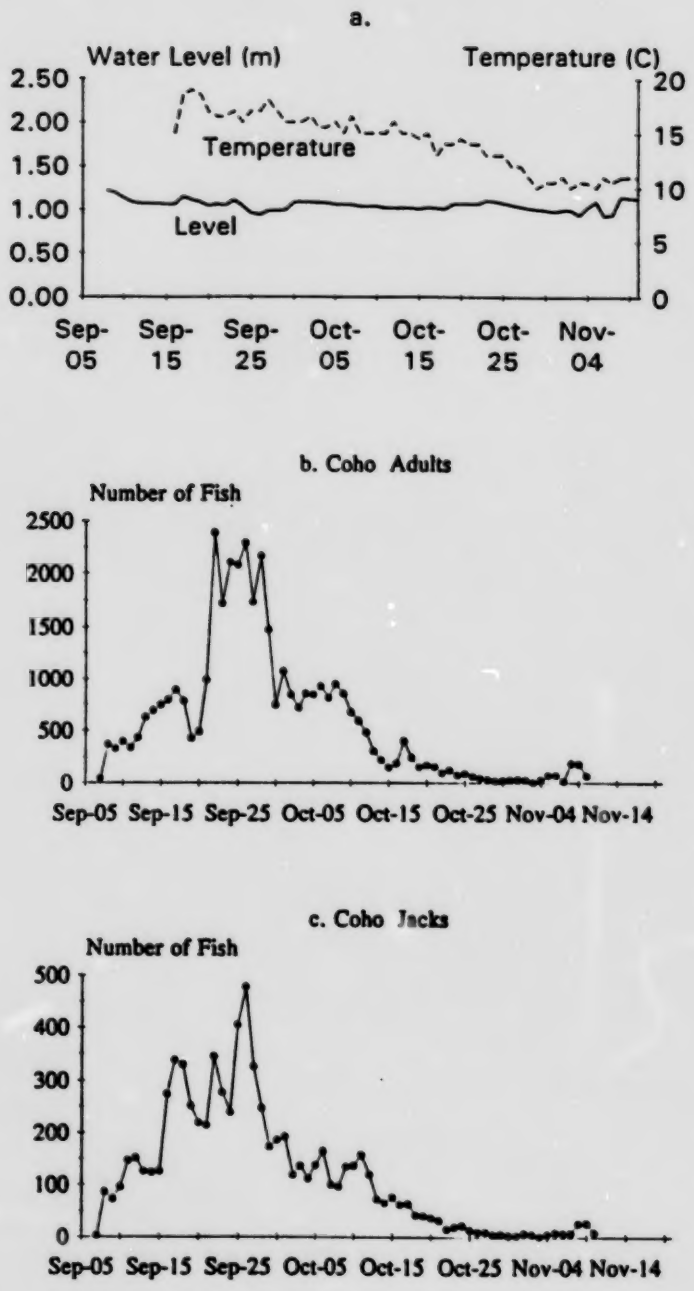

Figure 6. Daily water levels and temperatures at Stamp Falls (a). Adjusted daily counts of adult and jack coho at Stamp Falls (b and c).

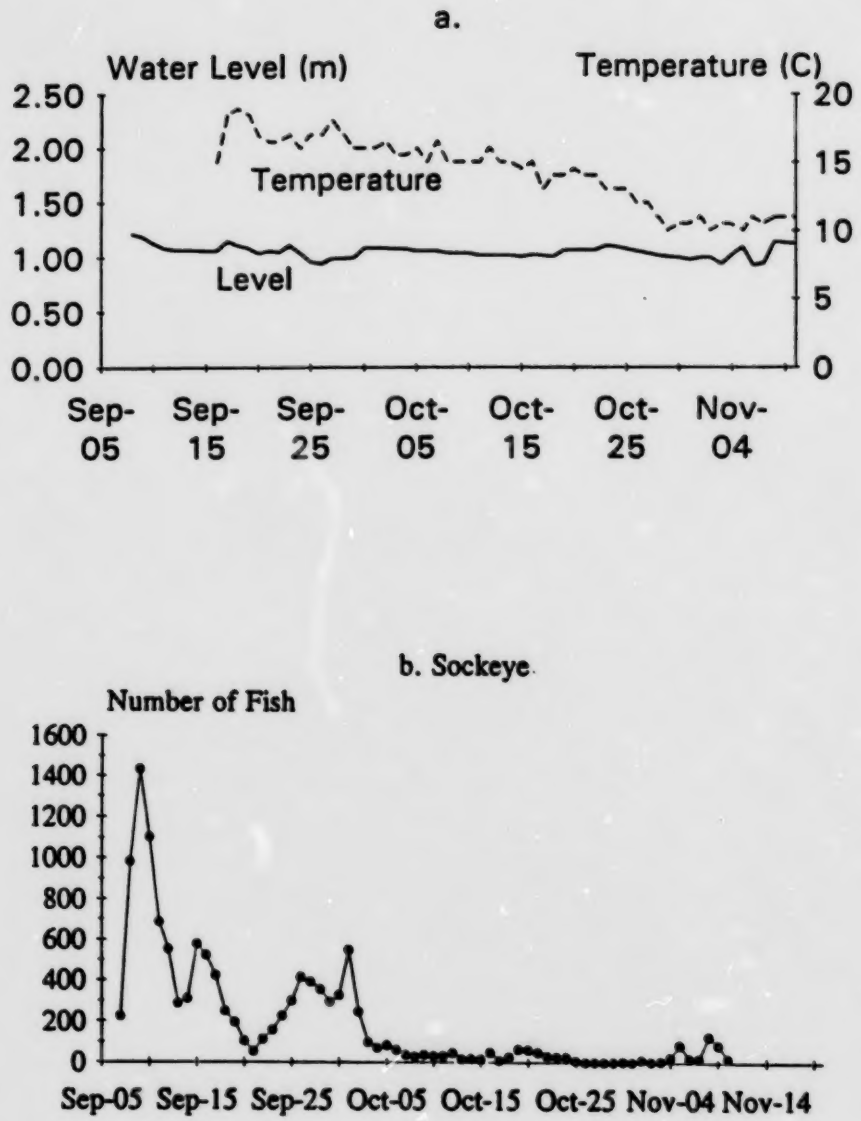

Figure 7. Daily water levels and temperatures at Stamp Falls (a). Adjusted daily counts of adult and jack sockeye at Stamp Falls (b).

Table 4. Mean time to recovery at Robertson Creek Hatchery and in the Stamp River dead pitch of adult chinook tagged at Stamp Falls fishway, 1991.

Tagging period	Number tagged	Number recovered		Mean time to recovery (days)	
		Hatchery	River	Hatchery	River
Sep 7 - Sep 15	65	3	1	39.3	43.0
Oct 16 - Oct 21	75	2	7	10.0	14.7

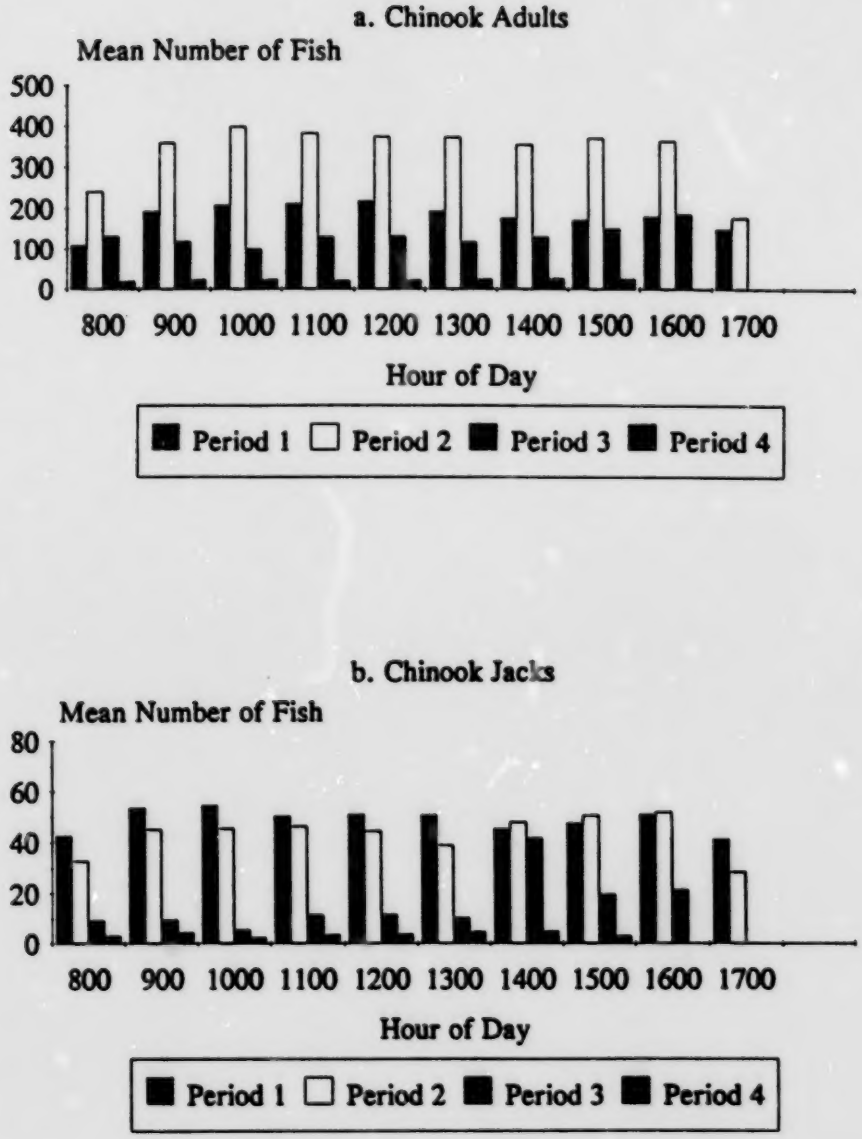

Figure 8. Hourly migration pattern for adult and jack chinook at Stamp Falls. Period 1 = 7 Sept to 24 Sept, Period 2 = 25 Sept to 18 Oct, Period 3 = 19 Oct to 23 Oct, and Period 4 = 2 Nov to 10 Nov.

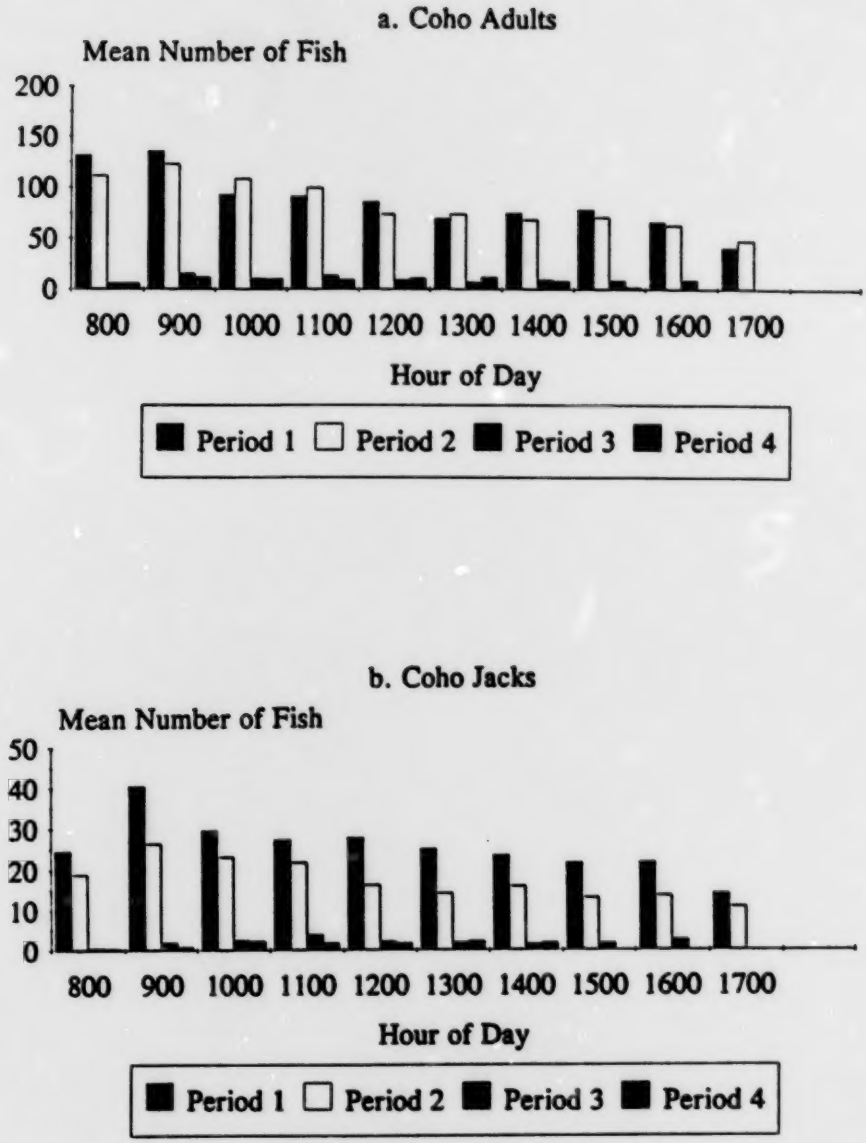

Figure 9. Hourly migration pattern for adult and jack coho salmon at Stamp Falls. Period 1 = 7 Sept to 24 Sept, Period 2 = 25 Sept to 18 Oct, Period 3 = 19 Oct to 23 Oct, and Period 4 = 2 Nov to 10 Nov.

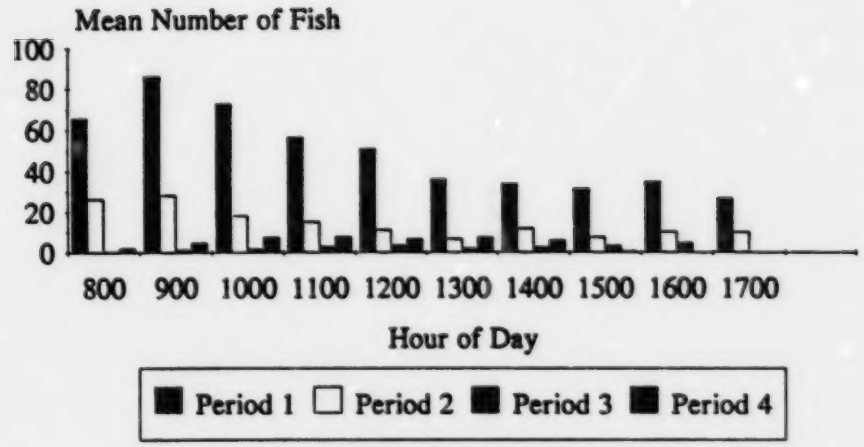

Figure 10. Hourly migration pattern for adult and jack sockeye at Stamp Falls. Period 1 = 7 Sept to 24 Sept, Period 2 = 25 Sept to 18 Oct, Period 3 = 19 Oct to 23 Oct, and Period 4 = 2 Nov to 10 Nov.

to discriminate between jacks and adults. Using daily verification tests, we were able to successfully quantify observer error.

Observer Error

There are a number of possible sources of error in the counts of salmonids passing through the Stamp Falls Fishway. The counting apparatus and counting techniques were designed to mitigate as many of these sources of error as possible. The primary sources of error include observer error (species identification and miscounts) and multiple passage of fish (layering of fish and fall-back within the fishway).

Multiple passage of fish was mitigated in the design of the counting apparatus. The opening in the panels was purposely kept small to prevent too many fish from passing over the flashboard at one time. Fall-back was minimized by setting the main fishway gates in a Vee formation to funnel the fish through the opening. This system worked well to minimize fall-back and once fish nosed through the panel opening, they moved quickly over the flashboard and out of the fishway.

Errors in species identification and enumeration (observer error), as determined from the verification tests at Stamp Falls, ranged between 76% and 136% of the true number depending on the sample period and fish species. Counts of chinook adults were the most precise and errors ranged from 89% to 107% over the migration period. However, after adjusting for counting error, the total counts for each species had 95% confidence intervals of between $\pm$ 1.0% for adult chinook and $\pm$6.0% coho jacks. The confidence interval for the population estimate for chinook jacks was $\pm$2.5%. The confidence interval for the population estimate for sockeye was $\pm$ 2.1% and for adult coho it was 3.8%. These confidence intervals accurately reflect the observers ability to count each species of salmon. Sockeye were easily distinguished from the other species because of their distinct spawning colours and the presence of scarring on the body or fins. Coho jacks were more difficult to enumerate because small jacks (< 30 cm) were still able to escape from the containment area during the verification tests, and during normal counting operations, even with vexar screening (5 cm) covering the aluminum panels. This difficulty was manifested in a highly variable efficiency of counting for jack coho and wider confidence intervals on the final population estimate. Chinook adults were easy to identify because of their large size and body shape. However, some of the adult coho returning to the Stamp River are also very large and were sometimes confused with small adult or jack chinook. Observers relied on differences between body colour (coho tend to be darker) and spotting on the posterior end of the fish (larger and wider spaced spots on chinook). Difficulties in distinguishing between large coho and small adult or jack chinook were particularly pronounced when fish swam quickly through the viewing area. Steelhead were easily identified from the other salmonids based on colour, the shape of the caudal peduncle, and fin ray coloration. We have no estimate, however, on the accuracy and precision of our counts for steelhead, pink, and chum salmon.

Incomplete Counts

During this study there were three possible causes of incomplete fish counts at the fishway. An unknown number of salmon of all species passed through the fishway prior to 7 September.

Secondly, another potential source for incomplete counts was the escape of small fish through the panel bars. This was minimized by using vexar screening (mesh size 5 cm). However, fish < 30 cm) could still pass through the vexar. This included coho jacks, and very small adult coho or sockeye. No attempt was made to correct for these missed fish. Lastly, fish bypassing the fishway and successfully negotiating Stamp Falls may have also contributed to incomplete fishway counts. Throughout the counting period, fish of all species were observed attempting to jump the falls. Many succeeded in reaching back eddies or small pools in the mid sections of the stepped falls. We attempted to quantify the number of fish bypassing the fishway by tagging adult chinook as they left the fishway and comparing mark rates of fish at the hatchery and in the dead recovery with mark rates at the fishway.

We tagged 140 adult chinook (Table 4) passing through the fishway (0.12%) and recovered only 5 at the hatchery (0.02%) and 8 in the deadpitch (0.05%). These recovery rates were significantly different ($\chi^2 = 25.2$, $p < 0.001$). There are several possible explanations for this difference: 1) fish bypassed the fishway in very large numbers, 2) tag detection was low at the hatchery and in the deadpitch, 3) there was higher mortability of tagged fish than untagged fish, 4) there was a high rate of tag loss, 5) tagged fish did not travel as far upriver and spawned or died below the area of intensive dead recovery effort, and 6) tagged fish fell back over the falls after tagging and did not re-ascend.

Explanation 2 would not likely explain such a large difference since hatchery crews handled every fish examined and were instructed to closely check for the presence of a tag. We have no way of assessing the extent of tag loss. Numbers 1, 3, 5 or 6 are the most plausible explanations for the difference in tag rates. These results suggest that there is not enough evidence to discount the possibility of fish bypassing the fishway, and further studies are warranted.

We recommend that a larger number of chinook be marked with operculum tags (> 1%, or 1,000 fish) in 1992.

Migration Timing

The analysis of diel migration at Stamp Falls Fishway illustrates that there is very little variability in the diel migration of chinook. Coho and sockeye tended to move in greater numbers during the early morning hours.

PART II: AGE, SIZE AND SEX ANALYSIS AND CODED WIRE TAG RECOVERIES

INTRODUCTION

This section of the report deals with the population characteristics (age, length and sex) of Stamp River chinook and the hatchery contributions to the total escapement. The Stamp River chinook escapement was stratified into two main groups: those chinook spawning in the upper Stamp River between Stamp Falls and Robertson Creek Hatchery (the "in-river" population) and those chinook returning to Robertson Creek Hatchery. The reason for this level of stratification was to compare differences in age, length and sex attributes of these two components of the total escapement as well as different hatchery contributions. It was hypothesized that there would be significant differences in age structure, length and sex between the in-river population and the hatchery population. As well, we hypothesized that the percentage of hatchery origin fish would be significantly higher in the hatchery than in the river.

We also examined two approaches to estimating the hatchery contribution to the Stamp River. The first of these methods (Method A) has been used in other documents for chinook keystreams (Andrew et al. 1988, Bocking et al. 1990, Carolsfeld et al. 1991, Bocking 1991a, Bocking 1991b) and uses the recovery rate of adipose clipped chinook to expand tag code specific recoveries. The second method used (Method B) was described by (Kuhn 1988) and uses the recovery of CWTs (not necessarily adipose clipped) in the escapement to estimate the hatchery contribution.

In this report "tagging" refers to the tagging of chinook juveniles with coded wire tags and marking with clipped adipose fins.

METHODS

Dead Recovery

Dead recovery in the Stamp River was conducted between 7 October and 6 November, 1991. During the dead pitch, the river was stratified into 10 areas stretching from Robertson Creek Hatchery to the lower Somass River (Fig. 11). For the purpose of the analyses conducted in this report these areas were amalgamated into 3 strata: upstream of the carcass weir (A), the carcass weir (B) and downstream of the carcass weir to Stamp Falls (C) (Fig. 11). There was also some sampling below Stamp Falls (Area 7-9). Data for recoveries in this area are presented in Appendix 2-1, but are not used in the analyses for this report because we have no estimate for fish spawning before the falls. The carcass weir was located at the upstream end of Stamp Lagoon, and consisted of a 150' x 8' net strung across a 250' wide part of the river. The net, made of polyweb with 5" mesh, was suspended between two 3/8" cables running the full width of the river and anchored to trees on each shore. The bottom cable was held to the river bottom by rebar hooks driven into the gravel. The top cable was

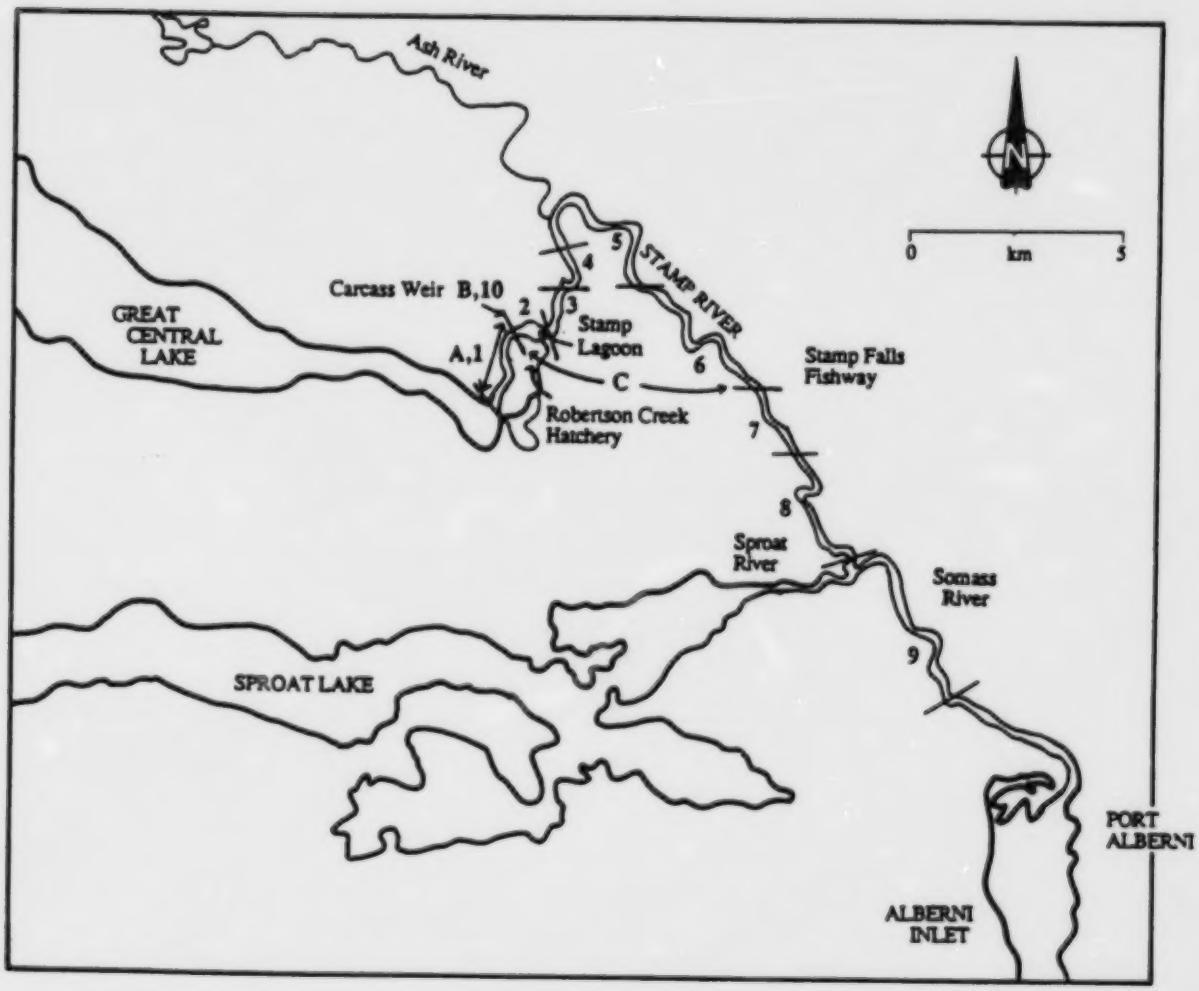

Figure 11. Map of Stamp River and Robertson Creek showing carcass recovery areas. Numbers are hatchery designations, letters are the authors' designation for this report.

connected to a winch on each shore to facilitate a total release of the top end in situations such as high water. Dead fish were recovered primarily by gaffing from a boat, and by walking the stream bank and shallow water between Stamp Lagoon and the Ash River confluence.

Carcasses recovered were measured (postorbital-hypural length) and examined for sex and missing adipose fins. A portion of the recovered carcasses was also sampled for scales, and all chinook with missing adipose fins had their heads removed for coded wire tag analysis. All carcasses were cut in half to prevent double counting.

Hatchery Returns

The staff at Robertson Creek Hatchery enumerated all chinook returning to the hatchery between 23 September and 21 November, 1991. Daily records included the number of males, females and jacks, missing adipose fins, some scales sampling and length measurements. Heads from all adipose clipped chinook were removed and analysed for coded wire tags.

Population Estimates

The total population of chinook returning to the Robertson Creek Hatchery was determined from brailer counts and stratified by males, females and jacks. The in-river population of adult chinook (above Stamp Falls) was determined by subtracting the total number of adult returns to the hatchery from the fishway count (see Part I). This estimate for adult chinook was then apportioned between males and females using the ratio of males to females as determined from the in-river dead recovery sample. The in-river population of jacks was determined by subtracting the number of jack returns to the hatchery from the fishway count of jack chinook.

Age, Length and Sex Analyses

Biological sampling during dead recovery and at the hatchery included scales for age determination, length, sex, and presence of an adipose clip. Males were considered to be jacks when their length was less than 59 cm. Some adipose clipped fish (CWT) were also sampled for age and length. Five scales were taken from each side of the fish from the preferred area and were placed on gum cards.

Scales were read at the DFO scale lab in Vancouver. Ages were only read when a portion of the previous annulus was present and scales were not regenerated. Scales were classified as unreadable if the scales had regenerate centres, were resorbed, or if they were mounted upside down. Ages were recorded for fish for which there were at least two scales that could be read for both marine and freshwater ages. In this report, the first numeral of the age recorded indicates the year of total life, and the decimal point and following numeral indicates the year of life in which the fish migrated to the ocean. The aging system follows that described by Gilbert and Rich (1972).

The age composition determined with the available samples is valid only if age sampling was random and there was no bias in the readability of scales with age. Ages of older fish are usually more difficult to read than those of young fish because scales of older fish undergo more resorption and regeneration. The data were examined for this potential bias by comparing mean lengths of known and unknown (scales unreadable or not sampled) aged males and females.

The age specific population estimates were then determined by allocating portions of the population estimate to age classes according to the age composition determined from scale samples. Sex ratios were determined for the in-river population and the hatchery.

Hatchery Contributions

Heads from adipose clipped chinook were removed and sent to the DFO tag recovery laboratory in Vancouver for dissection and tag decoding.

The estimation of the contribution of hatchery reared chinook to the total escapement utilizes the adipose or coded wire tag mark rate in the escapement. We used two different approaches (Method A and Method B) to determine the contribution of hatchery released chinook, by tag code, to the escapement. In the first approach, we used the dead recovery samples to estimate the total number of adipose clipped fish in the escapement, stratified by river location (in-river versus hatchery) and sex. We call this Method A. It should be noted that CWT expansions by the Mark Recovery Program for commercial and sport fisheries use Method B and, therefore, CWT expansions for escapements using Method A are not directly comparable.

Method A

Adipose clipped fish were enumerated separately for males and females in the Stamp River and at the Robertson Creek Hatchery. The recovery of jack chinook was included with the adult male recoveries in this analysis. The first step in determining hatchery contributions was to estimate the number of adipose clipped fish in each stratum (river versus hatchery) from the observed number of adipose clips:

$$EAD_{ij} = \frac{OAD_{ij} \cdot P_{ij}}{C_{ij}} \qquad (4)$$

where *EAD* is the estimated number of adipose clips, *OAD* is the number of adipose clips observed, *C* is the number of fish examined, *P* is the population estimate, and *i* and *r* are subscripts denoting sex and river location (stratum). The sex specific population estimates used here were from the age-structure analysis.

Given an estimate of the total number of adipose clips for each sex escaping to each portion of the system, the number of adipose clips for each tag code can be estimated by the allocation of adipose clips to tag code groups based on their relative frequency in the sample of decoded tags:

$$EAD_{i,r,tc} = \frac{EAD_{i,r} \cdot NDT_{i,r,tc}}{SumNDT_{i,r}} \quad (5)$$

where *tc* is a subscript denoted tag code and *NDT* is the number of successfully decoded tags for each tag code, strata and sex.

This approach of first estimating adipose clipped fish and then allocating these among the successfully decoded CWTs assumes that any adipose clipped fish not decoded (i.e. no pins) were once marked but lost their coded wire tag for some reason. If this assumption is incorrect, the calculation of the number of hatchery origin fish using this method would be positively biased. It is possible, especially in the dead pitch, that some fish identified as hatchery releases by missing adipose fins may be fish that have naturally lost their adipose fins through some other means, e.g. carcass decomposition, or mis-identification. If decomposition of adipose fins is occurring, then the adipose clip rate among hatchery fish recovered in the dead pitch should be higher than that observed at release. Other potential sources of bias in the hatchery contribution estimate derived using Method A are discussed in Bocking (1991a).

The hatchery contribution to each year's escapement, stratified by river location and sex, was calculated by expanding the estimated number of adipose clips from each tag code group in proportion to the percentage of juvenile fish having an adipose clip at time of release:

$$EHC_{i,r,tc} = \frac{EAD_{i,r,tc} \cdot (RC_{tc} + RUC_{tc})}{RC_{tc}} \quad (6)$$

where *EHC* is the estimated hatchery contribution, *RC* is the number of chinook released with adipose fin clips associated with tag code *tc*, and *RUC* is the number of chinook released without adipose fin clips associated with tag code *tc*.

These estimates of hatchery contribution, stratified by brood year (*t*), river location (*r*), sex (*i*) and tag code (*tc*) are summed to give the hatchery contribution of all tag codes to the entire escapement (*EHC*):

$$EHC_{t,r,i} = \sum_{i=1}^{n} EHC_{t,i,r,tc} \quad (7)$$

where *n* is the number of tag codes for a given brood year *t*.

Due to the potentially different ages at maturity of males and females, it is important that allocation of adipose clipped fish to tag codes be carried out separately by sex whenever possible. In this study, the sex of all fish sampled for CWTs was recorded so that it was possible to estimate the total escapement of tag codes by sex (males included jacks).

Method B

In the second approach used to estimate the hatchery contribution, we estimated the number of successfully decoded CWT chinook in the escapement, stratified by river and sex using the methods described for the Mark Recovery Program (Kuhn et al. 1988). The primary difference between this method and Method A is that Method B uses the number of actual CWTs present in the escapement from which to derive the hatchery contribution, whereas Method A uses the number of adipose clips present in the escapement.

Estimating the total number of CWT returns from each of the brood years, and for each tag code was done as follows.

First, the observed number of CWT recoveries was adjusted to account for "no pin" (no tag) recoveries:

$$ADJ_{i,r,tc} = OBS_{i,r,tc} \cdot \left[1 + \frac{LP}{K} + \frac{ND \cdot (K + LP)}{K \cdot (K + LP + NP)}\right] \quad (8)$$

where *ADJ* is the adjusted number of observed CWT fish, *OBS* is the observed number of CWT fish, *K* is the sum of all successfully decoded tags for all tag codes recovered, *LP* is the number of lost pin recoveries, *ND* is the number of no data recoveries, *NP* is the number of no pin recoveries, and *i*, *r*, and *tc* are subscripts denoting, sex, river location, and tag code.

This adjusted number of CWT recoveries is then used to estimate the total number of CWT returns for each tag code:

$$EST_{i,r,tc} = \frac{ADJ_{i,r,tc} \cdot P_{i,r}}{C_{i,r}} \quad (9)$$

where *EST* is the estimated number of CWT recoveries for a single tag code, *C* is the number of fish examined, *P* is the population estimate, and *i*, *r*, and *tc* are subscripts denoting sex, river, and tag code.

This approach of estimating the number of CWT chinook in the escapement assumes that any adipose clipped chinook found without CWTs were never marked. This assumption is only valid if chinook tagged with a particular tag code did not lose the CWT after release from the hatchery (i.e. after accounting for tag loss during a retention test). Since it has been demonstrated for CWT fish that 90% of tag loss occurs within 4 weeks of tagging (Blankenship 1990), any fish that have been released within this four week period are likely to continue to have some tag loss prior to being recovered in the fishery or escapement. Violation of the assumption of no tag loss will result in a negative bias in the hatchery contribution estimates. Other potential sources of bias in the hatchery contribute estimates derived using Method B are discussed in Bocking (1991a).

The hatchery contribution to each year's escapement, stratified by river location and sex, was calculated by expanding the estimated number of CWT fish from each tag code group in proportion to the percentage of juvenile fish having a CWT at time of release:

$$EHC_{i,t,sx} = \frac{EAD_{i,t,sx} \cdot (RM_{sx} + RUM_{sx})}{RM_{sx}} \quad (10)$$

where *EHC* is the estimated hatchery contribution, *RM* is the number of chinook released with CWTs in brood year *t*, and *RUM* is the number of chinook released without CWTs in brood year *t*.

As for Method A, these estimates of hatchery contribution by tag code were then summed to give the hatchery contribution of all tag codes to the entire escapement, stratified by river, sex and brood year:

$$EHC_{i,t,s} = \sum_{i=1}^{n} EHC_{i,t,sx} \quad (11)$$

where *n* is the number of tag codes for a given brood year *t*.

Percent hatchery contributions by sex and age were then calculated using the population estimates derived from the age structure analysis.

RESULTS

Age, Length and Sex Composition

All of the fish sampled in the Stamp River and Robertson Creek were ocean-reared; i.e. they left the river to rear in the ocean during their first year of life and are termed sub-ones in this report (Table 5). Total ages of Stamp River chinook ranged from 2 to 5 years. There were no 6-year-olds in the 1991 escapement. Age 3 and 4 males were equally dominant in the in-river population (Stamp River dead recovery) while females aged 4 were dominant. In the Robertson Creek Hatchery, the dominant male age group was 3-year-olds and the dominant female group was 4-year-olds.

Summaries of mean lengths by age are presented in Table 5. In this table, the total mean length (all ages) is weighted according to the number of fish sampled. Stamp River males (mean postorbital-hypural length = 63.3 cm) were slightly larger than Robertson Creek Hatchery male returns (mean postorbital-hypural length = 61.1 cm). This is likely because 3-year-old chinook

Table 5. Age-length (postorbital-hypural) distribution of chinook salmon carcasses recovered in the Stamp River and chinook salmon live returns to Robertson Creek Hatchery, 1991.

Location	Length class (cm)	Age													
		Males (a)							Females						
		2.1	3.1	4.1	5.1	6.1	Total	Unk(b)	2.1	3.1	4.1	5.1	6.1	Total	Unk (b)
Stamp River dead recovery															
	25-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	30-34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	35-39	2	0	0	0	0	2	2	0	0	0	0	0	0	1
	40-44	11	0	1	1	0	13	2	0	0	0	0	0	0	0
	45-49	6	0	0	0	0	6	0	0	0	0	0	0	0	0
	50-54	0	19	1	1	0	21	4	0	0	1	0	0	1	0
	55-59	0	47	3	1	0	51	7	0	5	1	0	0	6	0
	60-64	1	47	9	0	0	57	9	0	13	4	0	0	17	1
	65-69	1	10	29	2	0	42	4	0	6	31	0	0	37	2
	70-74	0	4	51	3	0	58	10	0	5	128	21	0	154	20
	75-79	0	0	25	10	0	35	9	0	4	58	58	0	120	16
	80-84	0	0	7	12	0	19	5	0	1	18	56	0	75	11
	85-89	0	0	2	6	0	8	0	0	0	2	11	0	13	2
	90-94	0	0	0	2	0	2	0	0	0	1	2	0	3	0
	95-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	100-104	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	21	127	128	38	0	314	52	0	34	244	148	0	426	53
	Percent	6.7	40.4	40.8	12.1	0.0	100.0		0.0	8.0	57.3	34.7	0.0	100.0	
	Mean	43.0	57.0	69.0	76.0	0.0	63.3(c)	63.0	0.0	64.0	71.0	77.0	0.0	72.5(c)	73.0
	SD	7.0	5.0	6.0	10.0	0.0	6.3 (c)	12.0	0.0	7.0	5.0	4.0	0.0	4.9 (c)	7.0
Robertson Creek Hatchery (d)															
	25-29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	30-34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	35-39	11	0	0	0	0	11	0	0	1	0	0	0	1	0
	40-44	11	0	0	0	0	11	0	0	0	0	0	0	0	0
	45-49	4	0	0	0	0	4	0	0	0	0	0	0	0	0
	50-54	1	9	0	0	0	10	0	0	1	0	0	0	1	0
	55-59	0	45	1	0	0	46	0	0	0	0	0	0	0	0
	60-64	0	50	3	0	0	53	4	0	8	4	0	0	12	0
	65-69	0	13	18	0	0	31	0	0	5	17	4	0	26	2
	70-74	0	1	33	1	0	35	2	0	3	75	9	0	87	3
	75-79	0	0	23	9	0	32	3	0	2	57	36	0	95	9
	80-84	0	0	2	3	0	5	3	0	0	15	58	0	73	1
	85-89	0	0	1	1	0	2	0	0	0	0	11	0	11	2
	90-94	0	0	0	0	0	0	0	0	0	0	1	0	1	0
	95-99	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	100-104	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	27	118	81	14	0	240	12	0	20	168	119	0	307	17
	Percent	11.3	49.2	33.8	5.8	0.0	100.0		0.0	6.5	54.7	38.8	0.0	100.0	
	Mean	40.0	58.0	70.0	76.0	0.0	61.1	70.0	0.0	62.0	72.0	78.0	0.0	73.7	74.0
	SD	4.0	4.0	5.0	3.0	0.0	4.3	9.0	0.0	9.0	4.0	4.0	0.0	4.5	6.0

(a) Includes jacks
(b) Unk = age unknown (scale unreadable)
(c) Weighted mean and standard deviation
(d) Weighted averages of marked and unmarked chinook

constituted a larger proportion of the male population in the hatchery (49.2%) than in the river (40.4%). When stratified by age, the mean length of Stamp River males was the same as for hatchery males. The mean length of females was similar for in-river fish and hatchery returns (72.5 and 73.7 cm, respectively). There was no significant difference (t-test, $p > 0.5$) between the mean length of chinook that were not aged and the weighted (all ages) mean length of aged chinook (Table 5).

The population estimates, stratified by river location, sex and age class, are shown in Table 6. The sex ratio in the hatchery, as determined from brailer counts was 19.5% females, 64.3% adult males and 16.2% jack males (Table 7). However, the age structure analysis produced a ratio of 19.5:71.4:9.1 (F:M:J) suggesting that as many as 2500 adult males were misclassified as jacks during the hatchery counting of returns. The sex ratio for the upper Stamp in-river population of chinook as determined from fishway counts minus the hatchery returns was 49.9:37.6:12.5. As for the hatchery returns, the age structure sex ratios of 49.9:46.8:3.4 suggest that as many as 8800 adult males were misidentified as jacks at the fishway counting operation. Table 7 lists the final, sex-specific population estimates using the observed counts and all age composition data.

Hatchery Contributions

The results of coded wire tag returns are presented below for the upper Stamp River and Robertson Creek Hatchery. Information includes the following:

1. the raw data and mark rates for the calculations;
2. estimates of the total escapement of adipose clips (Method A) and/or CWTs (Method B);
3. the observed and estimated escapement of adipose clips (Method A) or CWTs (Method B) by tag code, and the hatchery contribution to the escapement for each tag code; and
4. the estimated hatchery contribution to the escapement by age class.

In the upper Stamp River there were 619 adipose clipped chinooks recovered in the dead pitch (Appendix 2-1: mark rate = 3.7%) and 1327 at the Robertson Creek Hatchery (Appendix 2-2: mark rate = 3.8%). Table 8 shows the total estimated number of adipose clips in the in-river population and the hatchery returns. These mark rates represent the number of adipose clipped chinook as a percentage of the total number of chinook in each population (wild + hatchery stock).

Hatchery Contributions - Method A

Results from the decoding of adipose clipped fish from the upper Stamp River dead pitch and returns to Robertson Creek Hatchery are shown in Table 9. There were no stray CWT fish recovered in the Stamp River in 1991. A total of 528 CWT heads from adipose clipped fish recovered in the dead recovery were successfully decoded. A total of 1274 CWT heads recovered at the hatchery were successfully decoded. Age 2 males (jacks) were included with all other adult males for this analysis.

Table 6. Escapement estimates, by age, of chinook salmon escapement to upper Stamp River (above Stamp Falls, excluding hatchery) and Robertson Creek Hatchery, 1991.

Location	Age	Males (a)		Females	
		Number	Percent (b)	Number	Percent (b)
Stamp River (dead recovery)					
	2.1	3250	6.7	0	0.0
	3.1	19655	40.4	3858	8.0
	4.1	19810	40.8	27686	57.3
	5.1	5881	12.1	16793	34.7
	6.1	0	0.0	0	0.0
	Total (c)	48596	100.0	48338	100.0
Robertson Creek Hatchery					
	2.1	3198	11.3	0	0.0
	3.1	13978	49.2	449	6.5
	4.1	9595	33.8	3774	54.7
	5.1	1658	5.8	2673	38.8
	6.1	0	0.0	0	0.0
	Total (d)	28430	100.0	6897	100.0

(a) Includes jacks

(b) From Table 5

(c) Adjusted adult fishway count (Table 3) minus adult hatchery returns (Appendix 2-2), apportioned by sex ratios derived from dead recovery. Note: the total number of males includes 51% of the adult in-river population plus 100% of the jack population (see Table 7).

(d) Total hatchery returns

Table 7. Sex composition of escapement of chinook salmon into Robertson Creek Hatchery and of adjusted escapement through Stamp Falls Fishway using two different methods, 1991.

Location	Type of sampling	Females		Males		Jacks		Total	
		Number (a)	%	Number (a)	%	Number (a)	%	Number	%
Hatchery	Braile	6897	19.5	22716	64.3	5714	16.2	35327	100.0
Hatchery	Age-comp	6897	19.5	25232	71.4	3198	9.1	35327	100.0
Upper Stamp	Fishway	48338	49.9	36465	37.6	12131	12.5	96934	100.0
Upper Stamp	Age-comp	48338	49.9	45346	46.8	3250	3.4	96934	100.0

(a) From Table 6

Table 8. Estimates of the total escapement of adipose clipped fish to the upper Stamp River (above falls) and to the Robertson Creek Hatchery, 1991. The escapement estimates to the upper Stamp River are calculated as the fishway counts minus the returns to the hatchery.

Location and sex	Sample size (a) A	Observed adipose clips (b) B	Mark rate (%) C=(B/A)x100	Escapement estimate (c) D	Percentage of population sampled E=(A/D)x100	Total estimated adipose clips F=(B/A)xD
Upper Stamp River (e)						
Male (d)	8556	301	3.5	48596	17.6	1710
Female	8118	318	3.9	48338	16.8	1893
Total	16674	619	3.7	96934	17.2	3603
Robertson Creek Hatchery						
Male (d)	28430	1025	3.6	28430	100.0	1025
Female	6897	302	4.4	6897	100.0	302
Total	35327	1327	3.8	35327	100.0	1327

(a) From Appendix 2-1 for upper Stamp River and Appendix 2-2 for Robertson Creek Hatchery
(b) From Appendix 2-1 for upper Stamp River and Appendix 2-2 for Robertson Creek Hatchery
(c) Estimates are stratified among sexes according to hatchery braile and fishway counts (Table 7)
(d) Includes jacks
(e) Total adjusted counts at Stamp Falls Fishway less fish at Robertson Creek Hatchery

Table 9. Estimates of total escapement of adipose clipped chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the estimated adipose clips for calculating the expanded hatchery contribution in Table 11 (Method A).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Decoded adipose clips		Estimated adipose clips		Decoded adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F
1989	20145	3	0	20.6	0.0	12	0	12.5	0.0
	20146	3	0	20.6	0.0	10	0	10.4	0.0
	20147	1	0	6.9	0.0	8	0	8.4	0.0
	20148	1	0	6.9	0.0	3	0	3.1	0.0
	20149	0	0	0.0	0.0	5	0	5.2	0.0
	20150	0	0	0.0	0.0	3	0	3.1	0.0
	20151	0	0	0.0	0.0	11	0	11.5	0.0
	20152	0	0	0.0	0.0	7	0	7.3	0.0
	20153	0	0	0.0	0.0	11	0	11.5	0.0
	20230	1	0	6.9	0.0	6	0	6.3	0.0
	20231	0	0	0.0	0.0	5	0	5.2	0.0
	20232	0	0	0.0	0.0	3	0	3.1	0.0
	20645	1	0	6.9	0.0	27	0	28.2	0.0
	20646	2	0	13.7	0.0	16	0	16.7	0.0
	20647	1	0	6.9	0.0	3	0	3.1	0.0
	20648	1	0	6.9	0.0	2	0	2.1	0.0
	20948	0	0	0.0	0.0	5	0	5.2	0.0
	20949	3	0	20.6	0.0	13	0	13.6	0.0
	20950	0	0	0.0	0.0	9	0	9.4	0.0
	20951	1	0	6.9	0.0	16	0	16.7	0.0
	Subtotal	18	0	123.6	0.0	175	0	182.7	0.0
1988	25014	11	5	75.5	33.9	41	9	42.8	9.3
	25630	2	0	13.7	0.0	15	0	15.7	0.0
	25640	3	1	20.6	6.8	6	0	6.3	0.0
	25643	2	0	13.7	0.0	13	1	13.6	1.0
	25645	1	0	6.9	0.0	9	0	9.4	0.0
	25646	5	0	34.3	0.0	16	0	16.7	0.0
	25648	2	0	13.7	0.0	12	0	12.5	0.0
	25651	1	1	6.9	6.8	7	1	7.3	1.0
	25653	2	0	13.7	0.0	6	0	6.3	0.0
	25654	4	2	27.5	13.6	10	0	10.4	0.0
	25657	3	0	20.6	0.0	9	3	9.4	3.1
	25658	1	0	6.9	0.0	9	0	9.4	0.0
	25660	1	0	6.9	0.0	9	0	9.4	0.0
	25663	1	0	6.9	0.0	5	0	5.2	0.0
	25701	2	1	13.7	6.8	2	0	2.1	0.0
	25702	0	0	0.0	0.0	1	0	1.0	0.0
	25703	0	0	0.0	0.0	1	0	1.0	0.0
	25704	1	0	6.9	0.0	1	0	1.0	0.0

Table 9. Estimates of total escapement of adipose clipped chinook salmon to the upper Stamp River and *Robertson Creek Hatchery*, by tag code, *1991*. One decimal place is carried for the estimated adipose clips for calculating the expanded hatchery contribution in Table 11 (Method A).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Decoded adipose clips		Estimated adipose clips		Decoded adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F
	25705	1	0	6.9	0.0	5	0	5.2	0.0
	25836	13	4	89.3	27.1	45	4	47.0	4.1
	25837	9	2	61.8	13.6	57	5	59.5	5.2
	25838	7	0	48.1	0.0	43	1	44.9	1.0
	25839	6	1	41.2	6.8	25	0	26.1	0.0
	26055	9	1	61.8	6.8	28	3	29.2	3.1
	26056	5	3	34.3	20.4	31	1	32.4	1.0
	26057	6	1	41.2	6.8	77	3	80.4	3.1
	Subtotal	98	22	672.9	149.3	483	31	504.1	32.1
1987	24311	8	11	54.9	74.7	15	7	15.7	7.2
	24802	5	5	34.3	33.9	17	8	17.7	8.3
	24803	6	9	41.2	61.1	23	12	24.0	12.4
	24804	8	6	54.9	40.7	22	10	23.0	10.3
	24805	4	6	27.5	40.7	15	7	15.7	7.2
	24806	6	4	41.2	27.1	8	7	8.4	7.2
	24809	2	6	13.7	40.7	13	11	13.6	11.4
	24810	4	6	27.5	40.7	16	11	16.7	11.4
	24937	3	4	20.6	27.1	2	1	2.1	1.0
	24948	2	4	13.7	27.1	1	3	1.0	3.1
	24949	3	3	20.6	20.4	2	1	2.1	1.0
	24950	5	3	34.3	20.4	3	3	3.1	3.1
	24951	8	5	54.9	33.9	15	11	15.7	11.4
	24952	5	2	34.3	13.6	17	11	17.7	11.4
	24958	5	13	34.3	88.2	15	13	15.7	13.4
	24959	3	7	20.6	47.5	19	6	19.8	6.2
	24960	3	8	20.6	54.3	16	9	16.7	9.3
	24961	2	10	13.7	67.9	9	8	9.4	8.3
	25326	8	11	54.9	74.7	15	9	15.7	9.3
	25327	8	10	54.9	67.9	16	12	16.7	12.4
	25328	9	17	61.8	115.4	16	10	16.7	10.3
	25329	5	14	34.3	95.0	18	12	18.8	12.4
	Subtotal	112	164	769.0	1113.0	293	182	305.8	188.2
1986	24256	0	2	0.0	13.6	1	11	1.0	11.4
	24257	1	8	6.9	54.3	4	4	4.2	4.1
	24361	3	8	20.6	54.3	4	3	4.2	3.1
	24362	3	9	20.6	61.1	1	8	1.0	8.3
	24363	3	15	20.6	101.8	4	4	4.2	4.1
	24401	4	9	27.5	61.1	2	10	2.1	10.3

Table 9. Estimates of total escapement of adipose clipped chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the estimated adipose clips for calculating the expanded hatchery contribution in Table 11 (Method A).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Decoded adipose clips		Estimated adipose clips		Decoded adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F
	24514	0	4	0.0	27.1	0	2	0.0	2.1
	24515	0	3	0.0	20.4	0	2	0.0	2.1
	24516	1	6	6.9	40.7	1	3	1.0	3.1
	24517	0	3	0.0	20.4	2	5	2.1	5.2
	24518	1	3	6.9	20.4	0	4	0.0	4.1
	24519	1	5	6.9	33.9	3	5	3.1	5.2
	24520	0	3	0.0	20.4	2	4	2.1	4.1
	24644	1	5	6.9	33.9	0	2	0.0	2.1
	24645	2	4	13.7	27.1	1	3	1.0	3.1
	24646	1	2	6.9	13.6	2	2	2.1	2.1
	24647	0	2	0.0	13.6	3	4	3.1	4.1
	24648	0	2	0.0	13.6	1	3	1.0	3.1
	Subtotal	21	93	144.2	631.2	31	79	32.4	81.7
	Total CWT	249	279	1710	1893	982	292	1025	302
No head taken		10	6			0	0		
No data (5000)		2	3			3	0		
No pin (8000)		37	29			33	10		
Lost pin (9000)		3	1			7	0		
Observed adipose		301	318			1025	302		

(a) Abbreviations are: M = male, F = female

(b) Includes jacks

The allocations of the total escapement of adipose clips to tag codes recovered in each portion of the river (in-river versus hatchery) are shown in Tables 9 and 11. Table 10 lists the number ofCWT fish and adipose clipped fish released for each tag code (data from MRP database) . The estimated hatchery contributions to the 1991 escapement of chinook to the upper Stamp River and Robertson Creek Hatchery were 77375 and 29027, respectively (Table 11). The hatchery contribution to the total escapement of chinook each year, by age class is presented in Table 12. The hatchery contribution to the in-river population of Robertson Creek chinook was estimated to be 79.2% for males and 85.1% for females. This increased to 89.9% for males and 89.9% for females in the returns to the hatchery.

Hatchery Contributions - Method B

Results from the decoding of CWTs from the upper Stamp River dead pitch and returns to Robertson Creek Hatchery are shown in Table 13. This table shows the number of observed CWT fish in the escapement and the adjusted number of CWTs for each tag code (Equation 11). The allocations of the total escapement of CWT fish to tag codes recovered in each portion of the river (in-river versus hatchery) are shown in Tables 14 and 15. The estimated hatchery contributions to the 1990 escapement of chinook to the Stamp River and Robertson Creek Hatchery using Method B (MRP method) were 72280 and 30969, respectively (Table 15). The hatchery contribution to the total escapement of chinook each year, by age class is presented in Table 16. The hatchery contribution to the in-river population of Robertson Creek chinook was estimated to be 70.1% for males and 79.0% for females. This decreased to 87.7% for males and 87.6% for females in the returns to the hatchery.

DISCUSSION

Age, Length and Sex Composition

The age-length composition obtained from sampling river carcasses was very similar to the age structure obtained from hatchery returns. The percentage of jacks was much higher in the hatchery (9.1%) than in the river (3.4%). The age structure for females was virtually the same for the dead pitch and hatchery returns.

The lower proportion of females observed in the hatchery returns (19.5%) compared to the in-river dead recovery (49.9%) has been observed in other hatchery populations (Bocking et al. 1990, Lightly et al. 1988, Sibert and Schnute 1982).

Finally, the jack to adult male ratios determined from the age structure analysis revealed a serious bias in the discrimination of jack and adult males during field observations. Visual counts of chinook at the Stamp Falls Fishway (see Part I) and brailer counts of chinook returning to the hatchery overestimated the number of jack chinook in the population by as much as 300%. Our 1991

Table 10. CWT and adipose-clip release data for hatchery-reared chinook salmon returning to the Somass River system and Robertson Creek Hatchery, by tag code, 1991.

Brood year	CWT release group	Release numbers		CWT loss (%)	Days held	Adipose release status	
		CWT	Untagged			Clipped	Unclipped
1989	20145	19800	0	0.0	3	19800	0
	20146	21721	0	0.0	3	21721	0
	20147	21804	0	0.0	3	21804	0
	20148	17750	0	0.0	3	17750	0
	20149	17207	0	0.0	3	17207	0
	20150	14812	0	0.0	3	14812	0
	20151	20326	0	0.0	3	20326	0
	20152	21044	0	0.0	3	21044	0
	20153	20950	0	0.0	3	20950	0
	20230	17104	0	0.0	3	17104	0
	20231	17022	0	0.0	3	17022	0
	20232	17648	0	0.0	3	17648	0
	20645	25653	683278	0.0	3	25653	683278
	20646	26670	968593	0.0	3	26670	968593
	20647	25670	1431972	0.7	3	25851	1431791
	20648	26729	1107766	0.0	3	26729	1107766
	20948	25262	618148	1.0	3	25517	617893
	20949	26660	1018290	0.0	3	26660	1018290
	20950	26771	908745	0.0	3	26771	908745
	20951	27078	1217114	0.0	3	27078	1217114
1988	25014	25393	627708	0.1	3	25418	627683
	25630	10385	9	0.1	3	10394	0
	25640	9780	9	0.1	3	9789	0
	25643	9704	8	0.1	3	9712	0
	25645	9645	8	0.1	3	9653	0
	25646	9723	8	0.1	3	9731	0
	25648	9805	9	0.1	3	9814	0
	25651	9783	9	0.1	3	9792	0
	25653	9805	9	0.1	3	9814	0
	25654	10091	9	0.1	3	10100	0
	25657	9875	9	0.1	3	9884	0
	25658	9882	9	0.1	3	9891	0
	25660	10258	9	0.1	3	10267	0
	25663	9902	9	0.1	3	9911	0
	25701	9893	9	0.1	3	9902	0
	25702	9878	9	0.1	3	9887	0
	25703	9864	9	0.1	3	9873	0
	25704	9730	8	0.1	3	9738	0
	25705	9888	9	0.1	3	9897	0
	25836	25389	1489437	0.1	3	25414	1489412
	25837	25026	1075504	0.1	3	25051	1075479
	25838	24734	1414607	0.1	3	24759	1414582
	25839	25298	936521	0.1	3	25323	936496
	26055	25330	676910	0.1	3	25355	676885
	26056	25079	1765174	0.1	3	25104	1765149
	26057	24939	901048	0.1	3	24964	901023

Table 10. CWT and adipose-clip release data for hatchery-reared chinook salmon returning to the Somass River system and Robertson Creek Hatchery, by tag code, 1991.

Brood year	CWT release group	Release numbers		CWT loss (%)	Days held	Adipose release status	
		CWT	Untagged			Clipped	Unclipped
1987	24311	31137	322939	0.0	3	31137	322939
	24802	29450	305443	0.0	3	29450	305443
	24803	31791	0	0.0	3	31791	0
	24804	28912	0	0.0	3	28912	0
	24805	29111	0	0.0	3	29111	0
	24806	32201	0	0.0	3	32201	0
	24809	29554	306662	0.5	3	29703	306513
	24810	29060	301535	0.5	3	29206	301389
	24937	27033	413	1.5	3	27445	1
	24948	24137	369	1.5	3	24505	1
	24949	24691	0	0.0	3	24691	0
	24950	26264	0	0.0	3	26264	0
	24951	27071	530793	0.0	3	27071	530793
	24952	24270	475872	0.0	3	24270	475872
	24958	25913	898585	0.1	3	25939	898559
	24959	26354	904241	0.0	3	26354	904241
	24960	24425	838738	0.0	3	24425	838738
	24961	25921	890976	0.0	3	25921	890976
	25326	26695	497358	0.7	3	26883	497170
	25327	23657	412459	0.5	3	23776	412340
	25328	25640	484187	0.7	3	25821	484006
	25329	25951	496221	0.8	3	26160	496012
1986	24256	24175	1186784	4.2	3	25235	1185724
	24257	22396	112833	5.0	3	23575	111654
	24361	23973	1243529	0.8	3	24166	1243336
	24362	26805	1388942	1.0	3	27076	1388671
	24363	24283	1351824	0.7	3	24454	1351653
	24401	25922	1444366	0.7	3	26105	1444183
	24514	20615	164	0.8	3	20779	0
	24515	19981	160	0.8	3	20141	0
	24516	19089	153	0.8	3	19242	0
	24517	19187	0	0.0	3	19187	0
	24518	20878	0	0.0	3	20878	0
	24519	20065	0	0.0	3	20065	0
	24520	18814	96	0.5	3	18909	1
	24644	19990	102	0.5	3	20090	2
	24645	20790	107	0.5	3	20894	3
	24646	21154	242	1.1	3	21389	7
	24647	16952	194	1.1	3	17141	5
	24648	20840	238	1.1	3	21072	6
	Total hatchery	1801907	31237498			1808987	31230418

Table 11. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of adipose-clipped chinook in the escapement (from Table 9) to account for unclipped hatchery releases and hence to derive hatchery contributions to escapement (Method A). Expansion factor = (adipose-clipped releases + unclipped releases) / adipose-clipped releases.

Brood year	CWT release group	Release numbers (c)		Expansion Factor	Expanded hatchery contribution (a)			
					Upper Stamp River		Robertson Creek Hatchery	
		Clipped	Unclipped		M (b)	F	M (b)	F
1989	20145	19800	0	1.00	21	0	13	0
	20146	21721	0	1.00	21	0	10	0
	20147	21804	0	1.00	7	0	8	0
	20148	17750	0	1.00	7	0	3	0
	20149	17207	0	1.00	0	0	5	0
	20150	14812	0	1.00	0	0	3	0
	20151	20326	0	1.00	0	0	11	0
	20152	21044	0	1.00	0	0	7	0
	20153	20950	0	1.00	0	0	11	0
	20230	17104	0	1.00	7	0	6	0
	20231	17022	0	1.00	0	0	5	0
	20232	17648	0	1.00	0	0	3	0
	20645	25653	683278	27.64	190	0	779	0
	20646	26670	968593	37.32	512	0	623	0
	20647	25851	1431791	56.39	387	0	177	0
	20648	26729	1107766	42.44	291	0	89	0
	20948	25517	617893	25.21	0	0	132	0
	20949	26660	1018290	39.20	807	0	532	0
	20950	26771	908745	34.95	0	0	328	0
	20951	27078	1217114	45.95	315	0	767	0
	Subtotal				2565	0	3514	0
1988	25014	25418	627683	25.69	1941	872	1100	239
	25630	10394	0	1.00	14	0	16	0
	25640	9789	0	1.00	21	7	6	0
	25643	9712	0	1.00	14	0	14	1
	25645	9653	0	1.00	7	0	9	0
	25646	9731	0	1.00	34	0	17	0
	25648	9814	0	1.00	14	0	13	0
	25651	9792	0	1.00	7	7	7	1
	25653	9814	0	1.00	14	0	6	0
	25654	10100	0	1.00	27	14	10	0
	25657	9884	0	1.00	21	0	9	3
	25658	9891	0	1.00	7	0	9	0
	25660	10267	0	1.00	7	0	9	0
	25663	9911	0	1.00	7	0	5	0
	25701	9902	0	1.00	14	7	2	0
	25702	9887	0	1.00	0	0	1	0
	25703	9873	0	1.00	0	0	1	0

Table 11. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of adipose-clipped chinook in the escapement (from Table 9) to account for unclipped hatchery releases and hence to derive hatchery contributions to escapement (Method A). Expansion factor = (adipose-clipped releases + unclipped releases) / adipose-clipped releases.

Brood year	CWT release group	Release numbers (c)		Expansion Factor	Expanded hatchery contribution (a)			
					Upper Stamp River		Robertson Creek Hatchery	
		Clipped	Unclipped		M (b)	F	M (b)	F
	25704	9738	0	1.00	7	0	1	0
	25705	9897	0	1.00	7	0	5	0
	25836	25414	1489412	59.60	5320	1618	2800	247
	25837	25051	1075479	43.93	2715	596	2614	227
	25838	24759	1414582	58.13	2794	0	2609	60
	25839	25323	936496	37.98	1565	258	991	0
	26055	25355	676885	27.70	1711	188	809	86
	26056	25104	1765149	71.31	2448	1452	2308	74
	26057	24964	901023	37.09	1528	252	2981	115
	Subtotal				20241	5270	16354	1053
1987	24311	31137	322939	11.37	625	849	178	82
	24802	29450	305443	11.37	390	386	202	94
	24803	31791	0	1.00	41	61	24	12
	24804	28912	0	1.00	55	41	23	10
	24805	29111	0	1.00	27	41	16	7
	24806	32201	0	1.00	41	27	8	7
	24809	29703	306513	11.32	155	461	154	129
	24810	29206	301389	11.32	311	461	189	129
	24937	27445	1	1.00	21	27	2	1
	24948	24505	1	1.00	14	27	1	3
	24949	24691	0	1.00	21	20	2	1
	24950	26264	0	1.00	34	20	3	3
	24951	27071	530793	20.61	1132	699	323	234
	24952	24270	475872	20.61	707	280	366	234
	24958	25939	898559	35.64	1224	3145	558	479
	24959	26354	904241	35.31	727	1678	700	219
	24960	24425	838738	35.34	728	1919	590	329
	24961	25921	890976	35.37	486	2401	332	293
	25326	26883	497170	19.49	1071	1455	305	181
	25327	23776	412340	18.34	1008	1245	306	228
	25328	25821	484006	19.74	1220	2278	330	204
	25329	26160	496012	19.96	685	1897	375	248
	Subtotal				10723	19417	4987	3129
1986	24256	25235	1185724	47.99	0	651	50	546
	24257	23575	111654	5.74	39	311	24	24
	24361	24166	1243336	52.45	1080	2848	219	163
	24362	27076	1388671	52.29	1077	3194	55	433

Table 11. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of adipose-clipped chinook in the escapement (from Table 9) to account for unclipped hatchery releases and hence to derive hatchery contributions to escapement (Method A). Expansion factor = (adipose-clipped releases + unclipped releases) / adipose-clipped releases.

Brood year	CWT release group	Release numbers (c)		Expansion Factor	Expanded hatchery contribution (a)				
					Upper Stamp River			Robertson Creek Hatchery	
		Clipped	Unclipped		M (b)	F		M (b)	F
	24363	24454	1351653	56.27	1159	5729		235	233
	24401	26105	1444183	56.32	1547	3440		118	583
	24514	20779	0	1.00	0	27		0	2
	24515	20141	0	1.00	0	20		0	2
	24516	19242	0	1.00	7	41		1	3
	24517	19187	0	1.00	0	20		2	5
	24518	20878	0	1.00	7	20		0	4
	24519	20065	0	1.00	7	34		3	5
	24520	18909	1	1.00	0	20		2	4
	24644	20090	2	1.00	7	34		0	2
	24645	20894	3	1.00	14	27		1	3
	24646	21389	7	1.00	7	14		2	2
	24647	17141	5	1.00	0	14		3	4
	24648	21072	6	1.00	0	14		1	3
	Subtotal				4951	16458		716	2021
	Total hatchery				36231	41144	0	22824	6203

(a) Abbreviations are: M = male and F = female

(b) Includes jacks

(c) From Table 10

Table 12. Estimated hatchery contributions to the upper Stamp River and Robertson Creek Hatchery chinook salmon escapements, 1991. Contributions were calculated using expansion Method A for the estimated number of adipose clips (Table 11).

				Hatchery contribution (b)			
		Estimated escapement (a)		Male		Female	
Location	Age	Male (c)	Female	Number	%	Number	%
Upper Stamp River							
	2.1	3250	0	2565	78.9	0	0.0
	3.1	19655	3858	20241	103.0	5270	136.6
	4.1	19810	27686	10723	54.1	19417	70.1
	5.1	5881	16793	4951	84.2	16458	98.0
	6.1	0	0	0	0.0	0	0.0
	Total	48596	48338	38480	79.2	41144	85.1
Robertson Creek Hatchery							
	2.1	3198	0	3514	109.9	0	0.0
	3.1	13978	449	16354	117.0	1053	234.4
	4.1	9595	3774	4987	52.0	3129	82.9
	5.1	1658	2673	716	43.2	2021	75.6
	6.1	0	0	0	0.0	0	0.0
	Total	28430	6897	25571	89.9	6203	89.9

(a) From Table 6
(b) From Table 15
(c) Includes jacks

Table 13. Adjusted number of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the adjusted CWTs for estimating the total number of CWTs in Table 14 (Method B).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Observed CWTs		Adjusted CWTs		Observed CWTs		Adjusted CWTs	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F
1989	20145	3	0	3.2	0.0	12	0	12.2	0.0
	20146	3	0	3.2	0.0	10	0	10.2	0.0
	20147	1	0	1.1	0.0	8	0	8.1	0.0
	20148	1	0	1.1	0.0	3	0	3.0	0.0
	20149	0	0	0.0	0.0	5	0	5.1	0.0
	20150	0	0	0.0	0.0	3	0	3.0	0.0
	20151	0	0	0.0	0.0	11	0	11.2	0.0
	20152	0	0	0.0	0.0	7	0	7.1	0.0
	20153	0	0	0.0	0.0	11	0	11.2	0.0
	20230	1	0	1.1	0.0	6	0	6.1	0.0
	20231	0	0	0.0	0.0	5	0	5.1	0.0
	20232	0	0	0.0	0.0	3	0	3.0	0.0
	20645	1	0	1.1	0.0	27	0	27.4	0.0
	20646	2	0	2.1	0.0	16	0	16.3	0.0
	20647	1	0	1.1	0.0	3	0	3.0	0.0
	20648	1	0	1.1	0.0	2	0	2.0	0.0
	20948	0	0	0.0	0.0	5	0	5.1	0.0
	20949	3	0	3.2	0.0	13	0	13.2	0.0
	20950	0	0	0.0	0.0	9	0	9.1	0.0
	20951	1	0	1.1	0.0	16	0	16.3	0.0
	Subtotal	18	0	19.225	0	175	0	177.8	0
1988	25014	11	5	11.7	5.3	41	9	41.7	9.0
	25630	2	0	2.1	0.0	15	0	15.2	0.0
	25640	3	1	3.2	1.1	6	0	6.1	0.0
	25643	2	0	2.1	0.0	13	1	13.2	1.0
	25645	1	0	1.1	0.0	9	0	9.1	0.0
	25646	5	0	5.3	0.0	16	0	16.3	0.0
	25648	2	0	2.1	0.0	12	0	12.2	0.0
	25651	1	1	1.1	1.1	7	1	7.1	1.0
	25653	2	0	2.1	0.0	6	0	6.1	0.0
	25654	4	2	4.3	2.1	10	0	10.2	0.0
	25657	3	0	3.2	0.0	9	3	9.1	3.0
	25658	1	0	1.1	0.0	9	0	9.1	0.0
	25660	1	0	1.1	0.0	9	0	9.1	0.0
	25663	1	0	1.1	0.0	5	0	5.1	0.0
	25701	2	1	2.1	1.1	2	0	2.0	0.0
	25702	0	0	0.0	0.0	1	0	1.0	0.0
	25703	0	0	0.0	0.0	1	0	1.0	0.0
	25704	1	0	1.1	0.0	1	0	1.0	0.0

Table 13. Adjusted number of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the adjusted CWTs for estimating the total number of CWTs in Table 14 (Method B).

Brood year	CWT code	Upper Stamp River (a)				Robertson Creek Hatchery			
		Observed CWTs		Adjusted CWTs		Observed CWTs		Adjusted CWTs	
		M (b)	F	M	F	M	F	M	F
	25705	1	0	1.1	0.0	5	0	5.1	0.0
	25836	13	4	13.9	4.2	45	4	45.7	4.0
	25837	9	2	9.6	2.1	57	5	57.9	5.0
	25838	7	0	7.5	0.0	43	1	43.7	1.0
	25839	6	1	6.4	1.1	25	0	25.4	0.0
	26055	9	1	9.6	1.1	28	3	28.4	3.0
	26056	5	3	5.3	3.2	31	1	31.5	1.0
	26057	6	1	6.4	1.1	77	3	78.2	3.0
	Subtotal	98	22	104.7	23.2	483	31	490.7	31.0
1987	24311	8	11	8.5	11.6	15	7	15.2	7.0
	24802	5	5	5.3	5.3	17	8	17.3	8.0
	24803	6	9	6.4	9.5	23	12	23.4	12.0
	24804	8	6	8.5	6.3	22	10	22.4	10.0
	24805	4	6	4.3	6.3	15	7	15.2	7.0
	24806	6	4	6.4	4.2	8	7	8.1	7.0
	24809	2	6	2.1	6.3	13	11	13.2	11.0
	24810	4	6	4.3	6.3	16	11	16.3	11.0
	24937	3	4	3.2	4.2	2	1	2.0	1.0
	24948	2	4	2.1	4.2	1	3	1.0	3.0
	24949	3	3	3.2	3.2	2	1	2.0	1.0
	24950	5	3	5.3	3.2	3	3	3.0	3.0
	24951	8	5	8.5	5.3	15	11	15.2	11.0
	24952	5	2	5.3	2.1	17	11	17.3	11.0
	24958	5	13	5.3	13.7	15	13	15.2	13.0
	24959	3	7	3.2	7.4	19	6	19.3	6.0
	24960	3	8	3.2	8.4	16	9	16.3	9.0
	24961	2	10	2.1	10.5	9	8	9.1	8.0
	25326	8	11	8.5	11.6	15	9	15.2	9.0
	25327	8	10	8.5	10.5	16	12	16.3	12.0
	25328	9	17	9.6	17.9	16	10	16.3	10.0
	25329	5	14	5.3	14.7	18	12	18.3	12.0
	Subtotal	112	164	119.6	172.6	293	182	297.7	182.0
1986	24256	0	2	0.0	2.1	1	11	1.0	11.0
	24257	1	8	1.1	8.4	4	4	4.1	4.0
	24361	3	8	3.2	8.4	4	3	4.1	3.0
	24362	3	9	3.2	9.5	1	8	1.0	8.0
	24363	3	15	3.2	15.8	4	4	4.1	4.0
	24401	4	9	4.3	9.5	2	10	2.0	10.0

Table 13. Adjusted number of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the adjusted CWTs for estimating the total number of CWTs in Table 14 (Method B).

Brood year	CWT code	Upper Stamp River (a) Observed CWTs M (b)	F	Adjusted CWTs M	F	Robertson Creek Hatchery Observed CWTs M	F	Adjusted CWTs M	F
	24514	0	4	0.0	4.2	0	2	0.0	2.0
	24515	0	3	0.0	3.2	0	2	0.0	2.0
	24516	1	6	1.1	6.3	1	3	1.0	3.0
	24517	0	3	0.0	3.2	2	5	2.0	5.0
	24518	1	3	1.1	3.2	0	4	0.0	4.0
	24519	1	5	1.1	5.3	3	5	3.0	5.0
	24520	0	3	0.0	3.2	2	4	2.0	4.0
	24644	1	5	1.1	5.3	0	2	0.0	2.0
	24645	2	4	2.1	4.2	1	3	1.0	3.0
	24646	1	2	1.1	2.1	2	2	2.0	2.0
	24647	0	2	0.0	2.1	3	4	3.0	4.0
	24648	0	2	0.0	2.1	1	3	1.0	3.0
	Subtotal	21	93	22.4	97.9	31	79	31.5	79.0
Total hatchery		249	279	266.0	293.6	982	292	997.7	292.0
No head taken		14	12			6	0		
No data (5000)		2	3			3	0		
No pin (8000)		37	29			33	10		
Lost pin (9000)		3	1			7	0		
Observed adipose		301	318			1025	302		

(a) Abbreviations are: M = male and F = female

(b) Includes jacks

Table 14. Estimates of total escapement of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the estimated CWTs for calculating the expanded hatchery contribution in Table 15 (Method B).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Adjusted CWTs		Estimated CWTs		Adjusted CWTs		Estimated CWTs	
Brood year	CWT code	M (b)	F	M	F	M (b)	F	M	F
1989	20145	3.2	0.0	18.2	0.0	12.2	0.0	12.2	0.0
	20146	3.2	0.0	18.2	0.0	10.2	0.0	10.2	0.0
	20147	1.1	0.0	6.1	0.0	8.1	0.0	8.1	0.0
	20148	1.1	0.0	6.1	0.0	3.0	0.0	3.0	0.0
	20149	0.0	0.0	0.0	0.0	5.1	0.0	5.1	0.0
	20150	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0
	20151	0.0	0.0	0.0	0.0	11.2	0.0	11.2	0.0
	20152	0.0	0.0	0.0	0.0	7.1	0.0	7.1	0.0
	20153	0.0	0.0	0.0	0.0	11.2	0.0	11.2	0.0
	20230	1.1	0.0	6.1	0.0	6.1	0.0	6.1	0.0
	20231	0.0	0.0	0.0	0.0	5.1	0.0	5.1	0.0
	20232	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0
	20645	1.1	0.0	6.1	0.0	27.4	0.0	27.4	0.0
	20646	2.1	0.0	12.1	0.0	16.3	0.0	16.3	0.0
	20647	1.1	0.0	6.1	0.0	3.0	0.0	3.0	0.0
	20648	1.1	0.0	6.1	0.0	2.0	0.0	2.0	0.0
	20948	0.0	0.0	0.0	0.0	5.1	0.0	5.1	0.0
	20949	3.2	0.0	18.2	0.0	13.2	0.0	13.2	0.0
	20950	0.0	0.0	0.0	0.0	9.1	0.0	9.1	0.0
	20951	1.1	0.0	6.1	0.0	16.3	0.0	16.3	0.0
	Total	19.2	0.0	109.2	0.0	177.8	0.0	177.8	0.0
1988	25014	11.7	5.3	66.7	31.3	41.7	9.0	41.7	9.0
	25630	2.1	0.0	12.1	0.0	15.2	0.0	15.2	0.0
	25640	3.2	1.1	18.2	6.3	6.1	0.0	6.1	0.0
	25643	2.1	0.0	12.1	0.0	13.2	1.0	13.2	1.0
	25645	1.1	0.0	6.1	0.0	9.1	0.0	9.1	0.0
	25646	5.3	0.0	30.3	0.0	16.3	0.0	16.3	0.0
	25648	2.1	0.0	12.1	0.0	12.2	0.0	12.2	0.0
	25651	1.1	1.1	6.1	6.3	7.1	1.0	7.1	1.0
	25653	2.1	0.0	12.1	0.0	6.1	0.0	6.1	0.0
	25654	4.3	2.1	24.3	12.5	10.2	0.0	10.2	0.0
	25657	3.2	0.0	18.2	0.0	9.1	3.0	9.1	3.0
	25658	1.1	0.0	6.1	0.0	9.1	0.0	9.1	0.0
	25660	1.1	0.0	6.1	0.0	9.1	0.0	9.1	0.0
	25663	1.1	0.0	6.1	0.0	5.1	0.0	5.1	0.0
	25701	2.1	1.1	12.1	6.3	2.0	0.0	2.0	0.0
	25702	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0
	25703	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0
	25704	1.1	0.0	6.1	0.0	1.0	0.0	1.0	0.0

Table 14. Estimates of total escapement of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the estimated CWTs for calculating the expanded hatchery contribution in Table 15 (Method B).

		Upper Stamp River (a)				Robertson Creek Hatchery			
		Adjusted CWTs		Estimated CWTs		Adjusted CWTs		Estimated CWTs	
Brood year	CWT code	M (b)	F	M	F	M (b)	F	M	F
	25705	1.1	0.0	6.1	0.0	5.1	0.0	5.1	0.0
	25836	13.9	4.2	78.9	25.1	45.7	4.0	45.7	4.0
	25837	9.6	2.1	54.6	12.5	57.9	5.0	57.9	5.0
	25838	7.5	0.0	42.5	0.0	43.7	1.0	43.7	1.0
	25839	6.4	1.1	36.4	6.3	25.4	0.0	25.4	0.0
	26055	9.6	1.1	54.6	6.3	28.4	3.0	28.4	3.0
	26056	5.3	3.2	30.3	18.8	31.5	1.0	31.5	1.0
	26057	6.4	1.1	36.4	6.3	78.2	3.0	78.2	3.0
	Subtotal	104.7	23.2	594.5	137.8	490.7	31.0	490.7	31.0
1987	24311	8.5	11.6	48.5	68.9	15.2	7.0	15.2	7.0
	24802	5.3	5.3	30.3	31.3	17.3	8.0	17.3	8.0
	24803	6.4	9.5	36.4	56.4	23.4	12.0	23.4	12.0
	24804	8.5	6.3	48.5	37.6	22.4	10.0	22.4	10.0
	24805	4.3	6.3	24.3	37.6	15.2	7.0	15.2	7.0
	24806	6.4	4.2	36.4	25.1	8.1	7.0	8.1	7.0
	24809	2.1	6.3	12.1	37.6	13.2	11.0	13.2	11.0
	24810	4.3	6.3	24.3	37.6	16.3	11.0	16.3	11.0
	24937	3.2	4.2	18.2	25.1	2.0	1.0	2.0	1.0
	24948	2.1	4.2	12.1	25.1	1.0	3.0	1.0	3.0
	24949	3.2	3.2	18.2	18.8	2.0	1.0	2.0	1.0
	24950	5.3	3.2	30.3	18.8	3.0	3.0	3.0	3.0
	24951	8.5	5.3	48.5	31.3	15.2	11.0	15.2	11.0
	24952	5.3	2.1	30.3	12.5	17.3	11.0	17.3	11.0
	24958	5.3	13.7	30.3	81.5	15.2	13.0	15.2	13.0
	24959	3.2	7.4	18.2	43.9	19.3	6.0	19.3	6.0
	24960	3.2	8.4	18.2	50.1	16.3	9.0	16.3	9.0
	24961	2.1	10.5	12.1	62.7	9.1	8.0	9.1	8.0
	25326	8.5	11.6	48.5	68.9	15.2	9.0	15.2	9.0
	25327	8.5	10.5	48.5	62.7	16.3	12.0	16.3	12.0
	25328	9.6	17.9	54.6	106.5	16.3	10.0	16.3	10.0
	25329	5.3	14.7	30.3	87.7	18.3	12.0	18.3	12.0
	Subtotal	119.6	172.6	679.4	1027.6	297.7	182.0	297.7	182.0
1986	24256	0.0	2.1	0.0	12.5	1.0	11.0	1.0	11.0
	24257	1.1	8.4	6.1	50.1	4.1	4.0	4.1	4.0
	24361	3.2	8.4	18.2	50.1	4.1	3.0	4.1	3.0
	24362	3.2	9.5	18.2	56.4	1.0	8.0	1.0	8.0
	24363	3.2	15.8	18.2	94.0	4.1	4.0	4.1	4.0
	24401	4.3	9.5	24.3	56.4	2.0	10.0	2.0	10.0

Table 14. Estimates of total escapement of CWT chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. One decimal place is carried for the estimated CWTs for calculating the expanded hatchery contribution in Table 15 (Method B).

Brood year	CWT code	Upper Stamp River (a)				Robertson Creek Hatchery			
		Adjusted CWTs		Estimated CWTs		Adjusted CWTs		Estimated CWTs	
		M (b)	F	M	F	M (b)	F	M	F
	24514	0.0	4.2	0.0	25.1	0.0	2.0	0.0	2.0
	24515	0.0	3.2	0.0	18.8	0.0	2.0	0.0	2.0
	24516	1.1	6.3	6.1	37.6	1.0	3.0	1.0	3.0
	24517	0.0	3.2	0.0	18.8	2.0	5.0	2.0	5.0
	24518	1.1	3.2	6.1	18.8	0.0	4.0	0.0	4.0
	24519	1.1	5.3	6.1	31.3	3.0	5.0	3.0	5.0
	24520	0.0	3.2	0.0	18.8	2.0	4.0	2.0	4.0
	24644	1.1	5.3	6.1	31.3	0.0	2.0	0.0	2.0
	24645	2.1	4.2	12.1	25.1	1.0	3.0	1.0	3.0
	24646	1.1	2.1	6.1	12.5	2.0	2.0	2.0	2.0
	24647	0.0	2.1	0.0	12.5	3.0	4.0	3.0	4.0
	24648	0.0	2.1	0.0	12.5	1.0	3.0	1.0	3.0
	Subtotal	22.4	97.9	127.4	582.7	31.5	79.0	31.5	79.0
	Total hatchery	266.0	293.6	1510.5	1748.2	997.7	292.0	997.7	292.0
Escapement estimate		48596	48338			28430	6897		
Sample Size		8556	8118			28430	6897		

(a) Abbreviations are: M = male and F = female

(b) Includes jacks

Table 15. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of CWT chinook in the escapement (from Table 14) to account for untagged hatchery releases and hence to derive hatchery contributions to escapement.
Expansion factor = (CWT releases + untagged releases) / CWT releases.

Brood year	CWT release group	Release numbers		Expansion Factor	Expanded hatchery contribution (a)			
					Upper Stamp River		Robertson Creek Hatchery	
		CWT	Untagged (c)		M (b)	F	M	F
1989	20145	19800	0	1.00	18	0	12	0
	20146	21721	0	1.00	18	0	10	0
	20147	21804	0	1.00	6	0	8	0
	20148	17750	0	1.00	6	0	3	0
	20149	17207	0	1.00	0	0	5	0
	20150	14812	0	1.00	0	0	3	0
	20151	20326	0	1.00	0	0	11	0
	20152	21044	0	1.00	0	0	7	0
	20153	20950	0	1.00	0	0	11	0
	20230	17104	0	1.00	6	0	6	0
	20231	17022	0	1.00	0	0	5	0
	20232	17648	0	1.00	0	0	3	0
	20645	25653	683278	27.64	168	0	758	0
	20646	26670	968593	37.32	453	0	607	0
	20647	25670	1431972	56.78	344	0	173	0
	20648	26729	1107766	42.44	257	0	86	0
	20948	25262	618148	25.47	0	0	129	0
	20949	26660	1018290	39.20	713	0	518	0
	20950	26771	908745	34.95	0	0	320	0
	20951	27078	1217114	45.95	279	0	747	0
	Subtotal				2269	0	3423	0
1988	25014	25393	627708	25.72	1716	806	1071	231
	25630	10385	9	1.00	12	0	15	0
	25640	9780	9	1.00	18	6	6	0
	25643	9704	8	1.00	12	0	13	1
	25645	9645	8	1.00	6	0	9	0
	25646	9723	8	1.00	30	0	16	0
	25648	9805	9	1.00	12	0	12	0
	25651	9783	9	1.00	6	6	7	1
	25653	9805	9	1.00	12	0	6	0
	25654	10091	9	1.00	24	13	10	0
	25657	9875	9	1.00	18	0	9	3
	25658	9882	9	1.00	6	0	9	0
	25660	10258	9	1.00	6	0	9	0
	25663	9902	9	1.00	6	0	5	0
	25701	9893	9	1.00	12	6	2	0
	25702	9878	9	1.00	0	0	1	0
	25703	9864	9	1.00	0	0	1	0

Table 15. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of CWT chinook in the escapement (from Table 14) to account for untagged hatchery releases and hence to derive hatchery contributions to escapement.
Expansion factor = (CWT releases + untagged releases) / CWT releases.

Brood year	CWT release group	Release numbers		Expansion Factor	Expanded hatchery contribution (a)			
					Upper Stamp River		Robertson Creek Hatchery	
		CWT	Untagged (c)		M (b)	F	M	F
	25704	9730	8	1.00	6	0	1	0
	25705	9888	9	1.00	6	0	5	0
	25836	25389	1489437	59.66	4705	1495	2728	239
	25837	25026	1075504	43.98	2401	551	2547	220
	25838	24734	1414607	58.19	2471	0	2542	58
	25839	25298	936521	38.02	1384	238	966	0
	26055	25330	676910	27.72	1514	174	789	83
	26056	25079	1765174	71.38	2165	1342	2248	71
	26057	24939	901048	37.13	1351	233	2905	111
	Subtotal				17902	4870	15934	1019
1987	24311	31137	322939	11.37	552	784	173	80
	24802	29450	305443	11.37	345	356	196	91
	24803	31791	0	1.00	36	56	23	12
	24804	28912	0	1.00	49	38	22	10
	24805	29111	0	1.00	24	38	15	7
	24806	32201	0	1.00	36	25	8	7
	24809	29554	306662	11.38	138	428	150	125
	24810	29060	301535	11.38	276	428	185	125
	24937	27033	413	1.02	18	25	2	1
	24948	24137	369	1.02	12	25	1	3
	24949	24691	0	1.00	18	19	2	1
	24950	26264	0	1.00	30	19	3	3
	24951	27071	530793	20.61	1000	646	314	227
	24952	24270	475872	20.61	625	258	356	227
	24958	25913	898585	35.68	1082	2906	544	464
	24959	26354	904241	35.31	643	1549	682	212
	24960	24425	838738	35.34	643	1771	574	318
	24961	25921	890976	35.37	429	2216	323	283
	25326	26695	497358	19.63	953	1353	299	177
	25327	23657	412459	18.43	895	1155	300	221
	25328	25640	484187	19.88	1086	2118	323	199
	25329	25951	496221	20.12	610	1765	368	241
	Subtotal				9502	17978	4866	3033
1986	24256	24175	1186784	50.09	0	628	51	551
	24257	22396	112833	6.04	37	303	25	24
	24361	23973	1243529	52.87	962	2650	215	159
	24362	26805	1388942	52.82	961	2978	54	423

Table 15. Estimates of total escapement of hatchery-reared chinook salmon to the upper Stamp River and Robertson Creek Hatchery, by tag code, 1991. The expansion factor is used to expand the estimated number of CWT chinook in the escapement (from Table 14) to account for untagged hatchery releases and hence to derive hatchery contributions to escapement.
Expansion factor = (CWT releases + untagged releases) / CWT releases.

Brood year	CWT release group	Release numbers		Expansion Factor	Expanded hatchery contribution (a)			
					Upper Stamp River		Robertson Creek Hatchery	
		CWT	Untagged (c)		M (b)	F	M	F
	24363	24283	1351824	56.67	1031	5326	230	227
	24401	25922	1444366	56.72	1376	3199	115	567
	24514	20615	164	1.01	0	25	0	2
	24515	19981	160	1.01	0	19	0	2
	24516	19089	153	1.01	6	38	1	3
	24517	19187	0	1.00	0	19	2	5
	24518	20878	0	1.00	6	19	0	4
	24519	20065	0	1.00	6	31	3	5
	24520	18814	96	1.01	0	19	2	4
	24644	19990	102	1.01	6	31	0	2
	24645	20790	107	1.01	12	25	1	3
	24646	21154	242	1.01	6	13	2	2
	24647	16952	194	1.01	0	13	3	4
	24648	20840	238	1.01	0	13	1	3
	Subtotal				4410	15349	705	1989
Total hatchery					34083	38197	24927	6042

(a) Abbreviations are: M = male and F = female

(b) Includes jacks

(c) Untagged = AFC only (ie. tag lost) + unmarked (ie. no CWT/AFC applied)

Table 16. Estimated hatchery contribution to the upper Stamp River and Robertson Creek Hatchery chinook salmon escapement, 1991. Contributions were calculated using expansion Method B for the estimated number of CWTs (Table 15).

Location	Age	Estimated escapement (a)		Hatchery contribution (b)			
				Male		Female	
		Male (c)	Female	Number	%	Number	%
Upper Stamp River							
	2.1	3250	0	2269	69.8	0	0.0
	3.1	19655	3858	17902	91.1	4870	126.2
	4.1	19810	27686	9502	48.0	17978	64.9
	5.1	5881	16793	4410	75.0	15349	91.4
	6.1	0	0	0	0.0	0	0.0
	Total	48596	48338	34083	70.1	38197	79.0
Robertson Creek Hatchery							
	2.1	3198	0	3423	107.0	0	0.0
	3.1	13978	449	15934	114.0	1019	226.8
	4.1	9595	3774	4866	50.7	3033	80.4
	5.1	1658	2673	705	42.5	1989	74.4
	6.1	0	0	0	0.0	0	0.0
	Total	28430	6897	24927	87.7	[illegible]	87.6

(a) From Table 6
(b) From Table 15
(c) Includes jacks

data indicated that the size cutoff for jacks and adults used at the fishway (59 cm total length, approx. 50-54 cm postorbital-hypural) was appropriate. Therefore, errors in the identification of jack chinook are mostly due to observer error. If these visual count data are used inseason to assist fishery management, then errors of this magnitude can be serious. In this report we used the age structure data to generate age specific population estimates and hatchery contribution estimates.

Hatchery Contributions

Hatchery contribution estimates for 1991 were similar to those for 1990. Contributions to the in-river population were 5-10% lower than for the hatchery. Method A produced higher contribution estimates than Method B. This is consistent with other studies (Bocking et al. 1990, Bocking 1991a, Bocking 1991b). The reasons for this difference are discussed in detail in Bocking 1991a.

SUMMARY

Fishway Counts

Counts of adult salmon returning to spawn in the Stamp River were conducted at Stamp Falls Fishway using visual observations from 7 September to 10 November. Raw counts of salmon passing through the fishway were adjusted for observer error by comparing fish counts with verified counts of fish. The final estimate of chinook salmon was 132,261 $\pm$ 1,614. An estimated 45,517 $\pm$ 1,908 coho passed through the fishway and 12,344 $\pm$ 258 sockeye were counted.

Age, Length and Sex Composition

The age, length and sex composition of 1990 Stamp River chinook salmon were determined from carcass recovery and sampling of live returns to Robertson Creek Hatchery. The in-river population of spawners and the hatchery returns were analysed separately. Both male and female chinook in the in-river population were predominantly 4 years old. Female returns to Robertson Creek Hatchery were also predominantly 4 year olds but male returns to the hatchery were mostly 3 year olds. This difference in age structure for males in the river and at the hatchery accounts for a slight difference in the mean length of males in each of these populations. There was a much larger proportion of females among river spawners (49.9%) than among hatchery returns (19.5%). The results of this study revealed that there was considerable error (> 50%) in the identification of jack chinook by field crews. Aging by scales and coded wire tags indicated that counts at the fishway and the hatchery overestimated the number of jack chinook by as much as 300%.

Hatchery Contribution Estimates

Adipose clip mark rates for the in-river carcass recovery sample and the hatchery returns were 3.7% and 3.8%, respectively. Two methods were described and used to estimate hatchery contributions to the escapement. Using Method A, which expands the number of observed adipose clipped chinook, the hatchery contribution for the total Stamp River escapement was estimated at 84.2%. Using Method B, which expands the number of CWTs (excluding those with adipose clips only), the hatchery contribution was estimated at 78.1%. Both estimates varied among sexes and river versus hatchery spawners.

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APPENDICES

Appendix 1-1. Actual counts of adult chinook salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Sep-07									4	88				92
Sep-08	93	97	86	217	205	171	107	71	83	**1**				1131
Sep-09	148	170	**7**	145	205	280	236	324	273	258				2046
Sep-10	31	166	246	192	**3**	120	164	230	230	194				1576
Sep-11	108	290	**5**	302	405	284	279	275	283	184				2415
Sep-12	190	203	127	318	**15**	281	347	205	337	231				2254
Sep-13	70	178	246	299	231	263	**6**	114	189	167				1763
Sep-14		176	177	321	68	**3**	117	186	69					1117
Sep-15	147	289	**7**	154	305	221	254	193	176	157				1903
Sep-16	62	**2**	230	273	238	265	200	222	190	118				1800
Sep-17	77	195	271	75	207	196	106	161	186	97				1571
Sep-18	132	221	**4**	200	221	65	163	97	196	130				1429
Sep-19	30	178	227	162	196	119	149	**2**	186	192				1441
Sep-20	162	191	238	185	**50**	165	159	146	161	129				1586
Sep-21	122	**32**	206	184	206	158	162	49	149	147				1415
Sep-22	100	192	**34**	203	161	182	153	173	209	169				1576
Sep-23	99	129	**4**	158	197	126	79	124	159	117				1192
Sep-24	171	233	239	222	**10**	199	157	180	166	27				1604
Sep-25	179	126	144	280	**79**	196	181	128	194	183	142	117	37	1986
Sep-26	79	146	182	198	199	145	131	**25**	171	186	161	113		1736
Sep-27	95	187	161	203	103	**25**	160	133	139	124				1330
Sep-28	135	**16**	144	130	123	159	95	152	117	99	108	94	46	1418
Sep-29	87	168	**48**	126	190	149	106	99	175	109				1257
Sep-30	128	156	227	187	106	153	141	**59**	240	77				1474
Oct-01	229	276	312	308	353	**130**	198	401	325	104				2636
Oct-02	254	546	489	566	475	**33**	445	320	373	142				3643
Oct-03	355	408	453	335	325	**123**		348	277	180				2804
Oct-04	385	570	550	471	309	**93**	399	335	341					3453
Oct-05	367	382	402	336	350	**139**	323	245	256	132				2932
Oct-06	368	520	624	634	497	400	**266**	603	749	322				4983
Oct-07	373	760	864	921	869	768	829	824	722	404				7334
Oct-08	454	402	711	622	710	583	803	649	718	241				5893
Oct-09	367	413	444	**314**	534	518	546	478	562	185				4361
Oct-10	308	252	386	446	405	493	435	**245**	458					3428
Oct-11	278	**116**	378	449	388	374	445	431	437					3296
Oct-12	156	384	438	**185**	349	309	300	282	379					2782
Oct-13	275	**89**	418	417	372	401	353	377	323					3025
Oct-14	223	430	423	379	400	372	399	**132**	359					3117
Oct-15	246	339	276	277	259	336	255	**147**	315					2450
Oct-16	38	288	332	**114**	406	397	352	343	284					2554
Oct-17	257	392	351	366	**109**	441	395	382	395					3088
Oct-18	169	377	425	**211**	514	522	519	512	425					3674
Oct-19	328	374	**14**	397	374	373	448	369	354					3031

Appendix 1-1. Actual counts of adult chinook salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

	Hour of Day													
Date	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	Total
Oct-20	250	172	262	289	251	299	**104**	326	275					2228
Oct-21	269	164	198	208	228	**60**	232	277	200					1836
Oct-22	162	202	225	187	174	**71**	176	152	146					1495
Oct-23	143	160	106	197	192	**52**	237	250	200					1537
Oct-24	115	129	124	132	137	133	**72**	138	124					1104
Oct-25	139	100	79	93	**26**	114	79	63	127					820
Oct-26	77	75	53	55	54	62	72	63	61					572
Oct-27	67	41	36	26	46	77	38	66						397
Oct-28	69	55	38	50	51	42	41							346
Oct-29	30	26	28	30	28	36	30	49						257
Oct-30	32	21	8	10	21	24	61	41						218
Oct-31	24	24	34	23	25	23	26	22						201
Nov-01	17	33	55	43	28	45	53	49						323
Nov-02	35	31	26	15	21	26	40	18						212
Nov-03	26	20	4	6	6	5	9							76
Nov-04	28	18	41	57	34	35	50	10						273
Nov-05	34	23	32	31	31	37	31							219
Nov-06	19	20	23	8	13	12								95
Nov-07	4	10	7	14	11	13	6							65
Nov-08	13	46	26	14	65	56	38							258
Nov-09	14	29	16	14	11	10	12							106
Nov-10	6	6	6	8	0	2	2							30
TOTAL	9448	12464	12977	13992	13174	11964	12771	12295	13467	4894	411	324	83	118264

Appendix 1-2. Actual counts of jack chinook salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Sep-07									5	27				32
Sep-08	47	49	18	47	40	30	11	6	17	**3**				268
Sep-09	56	28	**3**	29	41	62	46	92	50	117				524
Sep-10	17	75	63	105	**2**	52	77	45	137	51				624
Sep-11	50	61	**4**	124	102	78	52	136	72	42				721
Sep-12	61	43	55	3	**4**	70	101	41	101	50				529
Sep-13	28	22	16	15	28	19	**2**	21	27	42				220
Sep-14		30	82	43	25	**0**	13	34	5					232
Sep-15	73	21	**9**	47	58	53	37	68	38	32				436
Sep-16	25	**2**	80	79	65	87	70	56	50	21				535
Sep-17	34	86	70	24	41	49	31	50	69	25				479
Sep-18	34	88	**3**	38	67	9	46	13	63	39				400
Sep-19	12	54	64	40	47	48	52	**4**	56	35				412
Sep-20	60	58	61	25	**15**	34	39	44	41	37				414
Sep-21	33	**8**	32	52	50	43	42	12	43	41				356
Sep-22	58	78	**13**	61	38	70	48	55	46	49				516
Sep-23	42	40	**1**	47	60	48	18	39	60	28				383
Sep-24	54	67	58	74	**0**	58	41	47	37	23				459
Sep-25	59	54	23	72	**27**	30	49	55	61	38	45	19	1	533
Sep-26	24	71	65	67	57	68	60	**10**	62	44	60	27		615
Sep-27	55	72	71	56	33	**7**	54	43	51	44				486
Sep-28	43	**7**	60	32	48	27	37	20	48	7	41	1	6	377
Sep-29	32	48	**12**	43	46	41	33	35	33	37				360
Sep-30	46	48	45	39	17	25	38	**16**	58	20				352
Oct-01	54	93	105	85	76	**32**	59	125	112	22				763
Oct-02	58	62	110	86	99	**217**	79	77	67	25				880
Oct-03	62	70	66	48	68	**132**	84	61	31	48				670
Oct-04	38	65	44	40	45	**16**	58	58	58					422
Oct-05	46	70	50	42	44	**29**	68	48	50	20				467
Oct-06	22	19	46	48	45	47	**28**	48	91	12				406
Oct-07	9	52	32	61	41	64	28	57	65	30				439
Oct-08	35	21	38	31	53	33	60	46	55	21				393
Oct-09	27	14	31	**20**	29	45	44	42	58	28				339
Oct-10	30	19	29	25	22	41	37	**24**	56					283
Oct-11	24	**7**	37	30	38	41	69	47	47					340
Oct-12	20	48	39	**19**	47	35	38	51	28					325
Oct-13	22	**19**	33	31	31	30	33	41	34					274
Oct-14	16	24	31	32	32	39	55	**10**	41					280
Oct-15	20	27	20	37	27	42	25	**23**	45					266
Oct-16	8	20	38	**16**	41	36	36	33	25					253
Oct-17	22	35	15	21	**9**	32	19	30	35					218
Oct-18	13	15	18	**14**	38	20	38	41	32					229
Oct-19	29	28	**3**	38	22	34	45	55	43					297

Appendix 1-2. Actual counts of jack chinook salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

	Hour of Day													
Date	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	Total
Oct-20	16	14	19	28	22	25	**13**	44	22					203
Oct-21	19	28	18	20	27	**7**	28	33	39					219
Oct-22	10	8	7	16	20	**7**	22	17	16					123
Oct-23	11	8	4	10	15	**9**	17	30	20					124
Oct-24	7	11	4	11	14	12	**8**	19	11					97
Oct-25	8	4	3	6	**3**	11	7	7	14					63
Oct-26	4	10	2	6	4	6	4	6	5					47
Oct-27	13	2	4	5	4	2	7	7						44
Oct-28	1	2	0	2	2	1	3							11
Oct-29	0	1	0	2	1	3	1	4						12
Oct-30	2	3	1	1	2	4	7	8						28
Oct-31	2	5	3	2	5	6	3	4						30
Nov-01	0	2	3	6	6	10	9	2						38
Nov-02	2	7	1	3	3	5	6	4						31
Nov-03	5	3	2	0	0	1	3							14
Nov-04	6	4	2	1	5	6	9	3						36
Nov-05	6	4	1	6	4	3	6							30
Nov-06	3	2	2	3	0	4	5							19
Nov-07	1	0	1	2	0	1	0							5
Nov-08	3	14	2	11	14	14	6							64
Nov-09	6	3	10	1	4	2	3							29
Nov-10	0	4	0	2	1	1	2							10
TOTAL	1623	1957	1782	2030	1874	2114	2069	2047	2330	1058	146	47	7	19084

Appendix 1-3. Actual counts of adult coho salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Sep-07									24	19				43
Sep-08	45	20	32	23	70	87	27	23	18	**2**				347
Sep-09	24	25	**3**	34	40	34	20	47	26	57				310
Sep-10	6	67	28	71	**6**	59	37	29	47	22				372
Sep-11	29	44	**2**	50	31	39	33	40	32	19				319
Sep-12	38	60	42	64	**6**	55	51	30	37	23				406
Sep-13	39	83	87	118	78	81	**5**	38	40	15				584
Sep-14		80	73	117	31	**12**	113	147	69					642
Sep-15	99	191	**8**	43	121	62	85	49	44	26				728
Sep-16	89	**6**	92	136	109	108	69	83	59	25				776
Sep-17	104	185	128	70	94	63	68	64	63	35				874
Sep-18	168	182	**8**	92	81	26	48	53	85	23				766
Sep-19	33	74	65	48	42	24	41	**9**	59	27				422
Sep-20	102	57	62	53	**14**	36	45	44	45	21				479
Sep-21	222	**49**	128	113	59	68	92	37	125	78				971
Sep-22	482	266	**41**	194	164	131	165	245	202	187				2077
Sep-23	268	313	**11**	175	200	104	135	130	103	58				1497
Sep-24	352	382	287	151	**7**	143	175	197	115	18				1827
Sep-25	243	229	157	187	**79**	170	204	158	145	106	66	60	2	1806
Sep-26	255	366	232	209	135	201	72	**97**	211	138	57	17		1990
Sep-27	211	272	210	143	134	**49**	148	164	120	56				1507
Sep-28	412	**57**	284	211	142	170	178	134	86	72	57	69	9	1881
Sep-29	267	198	**88**	111	81	110	70	75	52	31				1083
Sep-30	102	112	57	50	35	55	54	**27**	39	17				548
Oct-01	127	108	112	118	94	**22**	40	56	78	30				785
Oct-02	84	107	94	79	61	**16**	55	80	33	8				617
Oct-03	68	116	79	51	39	**14**	34	41	52	31				525
Oct-04	128	83	82	61	58	**26**	62	64	61					625
Oct-05	45	141	103	64	58	**30**	45	57	48	26				617
Oct-06	100	141	135	123	97	69	**45**	85	86	43				924
Oct-07	53	108	96	133	74	95	84	66	63	40				812
Oct-08	94	78	116	117	116	80	117	81	99	44				942
Oct-09	94	144	113	**79**	117	60	69	72	76	25				849
Oct-10	103	52	131	90	87	46	71	**52**	41					673
Oct-11	82	**46**	107	80	87	52	31	50	58					593
Oct-12	36	111	87	**43**	49	46	36	49	25					482
Oct-13	65	**20**	65	55	53	20	29	29	26					362
Oct-14	20	32	37	33	36	33	36	**14**	19					260
Oct-15	19	31	29	24	10	21	16	**6**	19					175
Oct-16	12	35	42	**8**	25	23	29	26	21					221
Oct-17	52	83	85	60	**34**	38	45	37	31					465
Oct-18	7	29	37	**30**	39	46	51	26	22					287
Oct-19	11	46	**3**	41	21	18	22	7	12					181

Appendix 1-3. Actual counts of adult coho salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Oct-20	17	21	30	32	11	16	8	17	17					169
Oct-21	10	24	23	11	19	11	15	28	10					151
Oct-22	9	23	12	18	8	6	9	5	5					95
Oct-23	4	22	10	22	19	6	13	16	9					121
Oct-24	1	11	9	11	13	9	5	4	9					72
Oct-25	3	21	18	10	7	6	10	9	5					89
Oct-26	2	11	13	11	2	5	7	5	2					58
Oct-27	8	8	4	6	8	3	5	2						44
Oct-28	6	9	3	3	3	2	5							31
Oct-29	1	1	3	3	3	0	4	2						17
Oct-30	2	0	0	3	1	6	7	2						21
Oct-31	2	2	2	3	4	5	5	5						28
Nov-01	2	6	8	5	5	4	1	3						34
Nov-02	2	2	5	3	3	5	4	2						26
Nov-03	1	0	0	2	1	1	1							6
Nov-04	2	5	4	2	7	6	3	1						30
Nov-05	13	13	12	5	10	7	11							71
Nov-06	12	9	5	17	0	21	7							71
Nov-07	0	3	2	2	5	4	3							19
Nov-08	8	22	21	15	51	39	28							184
Nov-09	19	40	31	30	21	19	16							176
Nov-10	1	18	13	10	6	11	7							66
TOTAL	4915	5100	3906	3976	3121	2834	3026	2919	2773	1322	180	146	11	34229

Appendix 1-4. Actual counts of jack coho salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Sep-07									0	3				3
Sep-08	11	10	8	2	16	23	5	6	12	**0**				93
Sep-09	4	6	**0**	5	8	19	11	18	4	4				79
Sep-10	3	6	3	18	4	16	12	3	20	18				103
Sep-11	9	14	2	31	23	18	19	11	26	4				157
Sep-12	9	14	9	23	1	20	25	32	20	10				163
Sep-13	7	8	16	30	19	14	**0**	9	25	7				135
Sep-14		19	15	34	3	2	20	24	16					133
Sep-15	7	19	1	8	22	10	33	17	22	13				152
Sep-16	28	1	38	58	33	60	33	40	24	15				330
Sep-17	39	86	63	24	40	44	35	35	19	23				408
Sep-18	46	122	1	28	53	15	47	20	40	26				398
Sep-19	16	42	42	46	40	30	21	4	30	33				304
Sep-20	37	30	31	23	9	40	26	28	17	24				265
Sep-21	29	16	43	25	27	14	25	25	43	12				259
Sep-22	49	72	13	53	33	43	30	35	35	21				384
Sep-23	27	97	5	31	44	20	22	25	26	12				309
Sep-24	72	61	57	24	1	14	10	17	11	0				267
Sep-25	59	84	51	65	24	29	46	26	27	12	16	9	3	451
Sep-26	89	94	55	61	51	33	38	17	32	39	17	6		532
Sep-27	49	55	48	38	33	17	38	35	26	25				364
Sep-28	60	12	35	48	27	20	23	16	13	11	7	3	1	276
Sep-29	40	25	14	29	14	10	16	16	12	11				187
Sep-30	39	24	19	22	17	24	17	14	15	10				201
Oct-01	17	36	38	16	25	12	11	16	29	8				208
Oct-02	5	12	30	9	18	8	20	11	15					128
Oct-03	6	42	22	17	11	10	14	7	14	4				147
Oct-04	15	15	25	13	15	8	7	14	8					120
Oct-05	8	28	21	14	9	12	20	15	19	2				148
Oct-06	8	22	24	19	11	7	19	20	16	8				154
Oct-07	0	4	8	11	9	17	15	7	14	9				94
Oct-08	3	6	13	11	14	8	17	14	4	1				91
Oct-09	7	13	17	6	22	15	17	9	20	0				126
Oct-10	6	15	30	16	12	11	12	11	15					128
Oct-11	17	21	33	12	13	19	12	11	9					147
Oct-12	11	29	16	6	16	13	9	6	6					112
Oct-13	6	5	10	8	6	9	9	3	8					64
Oct-14	2	16	4	8	5	10	3	3	7					58
Oct-15	0	12	7	10	11	6	8	5	8					67
Oct-16	0	4	9	5	12	8	8	7	2					55
Oct-17	2	9	12	6	1	12	2	8	4					56
Oct-18	2	8	4	3	5	4	3	6	2					37
Oct-19	2	3	1	8	4	4	2	6	6					36

Appendix 1-4. Actual counts of jack coho salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

	Hour of Day													
Date	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	Total
Oct-20	0	5	8	10	1	2	**1**	4	6					37
Oct-21	2	8	3	4	5	**3**	3	1	3					32
Oct-22	0	4	2	3	3	**1**	2	0	1					16
Oct-23	0	1	2	8	1	**0**	4	3	1					20
Oct-24	0	0	9	3	5	2	**1**	2	0					22
Oct-25	0	0	2	5	**1**	3	1	0	2					14
Oct-26	1	1	0	3	4	0	0	0	1					10
Oct-27	1	0	1	2	0	3	1	2						10
Oct-28	0	1	1	2	0	0	1							5
Oct-29	0	0	1	1	2	1	1	0						6
Oct-30	0	1	0	0	0	2	1							4
Oct-31	0	0	0	1	0	2	0	0						3
Nov-01	1	1	1	3	0	1	1	0						8
Nov-02	0	0	0	0	2	2	2	0						6
Nov-03	1	0	0	0	0	1	0							2
Nov-04	0	0	2	1	2	1	0	0						6
Nov-05	0	0	2	1	2	2	2							9
Nov-06	2	0	2	0	0	3	1							8
Nov-07	0	1	3	1	1	2	0							8
Nov-08	0	1	8	3	5	3	6							26
Nov-09	0	3	3	6	3	7	5							27
Nov-10	0	2	1	3	2	0	1							9
TOTAL	854	1246	944	984	800	769	794	664	735	365	40	18	4	8217

Appendix 1-5. Actual counts of sockeye salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

Date	Hour of Day													Total
	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
Sep-07									72	137				209
Sep-08	70	82	140	129	186	106	68	23	105	**10**				919
Sep-09	64	80	**5**	172	201	126	160	181	201	148				1338
Sep-10	19	262	254	140	**1**	115	54	83	53	48				1029
Sep-11	159	136	**5**	128	83	41	36	16	23	14				641
Sep-12	121	112	66	91	**0**	39	29	20	20	19				517
Sep-13	37	50	35	31	8	30	**1**	26	34	16				268
Sep-14		137	55	35	5	**6**	14	28	11					291
Sep-15	152	116	**6**	32	48	23	68	22	29	6				502
Sep-16	92	**9**	113	71	33	46	29	40	12	9				454
Sep-17	83	102	55	26	27	8	26	18	18	5				368
Sep-18	45	58	**1**	43	25	11	15	5	9	5				217
Sep-19	31	48	30	11	19	3	14	**2**	9	3				170
Sep-20	34	17	10	6	**5**	6	1	5	4	2				90
Sep-21	15	**2**	7	4	5	1	4	3	2	3				46
Sep-22	29	24	**4**	7	10	2	2	10	10	4				102
Sep-23	34	39	**0**	20	9	8	10	7	6	8				141
Sep-24	66	34	36	16	**1**	14	10	17	11	0				205
Sep-25	55	51	27	18	**12**	14	33	7	9	16	15	14	3	274
Sep-26	78	78	43	25	22	13	16	**21**	16	26	26	13		377
Sep-27	84	75	34	37	30	**6**	23	24	29	14				356
Sep-28	83	**16**	28	20	16	26	23	15	17	21	28	24	6	323
Sep-29	82	75	**23**	26	24	9	14	11	17	16				297
Sep-30	66	44	39	22	18	14	17	**31**	49	28				328
Oct-01	92	106	115	65	51	**18**	35	30	31	6				549
Oct-02	32	57	49	31	19	**4**	28	11	13	3				247
Oct-03	12	28	16	12	2	**4**	12	7	2	3				98
Oct-04	8	12	12	16	2	**2**	7	2	9					70
Oct-05	9	17	9	6	9	**4**	11	4	11	1				81
Oct-06	1	18	12	8	5	2	**7**	3	3	0				59
Oct-07	0	6	9	1	4	4	4	4	2	2				36
Oct-08	2	1	1	2	7	4	5	2	2	1				27
Oct-09	9	1	1	**3**	2	3	7	5	3	2				36
Oct-10	5	0	4	4	3	0	5	**4**	3					28
Oct-11	2	**4**	4	4	3	3	3	2	3					28
Oct-12	4	7	4	**3**	5	5	5	1	10					44
Oct-13	2	**2**	3	1	1	2	0	2	2					15
Oct-14	2	4	1	1	2	2	2	**1**	2					17
Oct-15	0	2	1	2	2	1	2	**3**	2					15
Oct-16	1	8	1	**3**	11	11	6	7	2					50
Oct-17	0	1	1	1	**0**	2	1	1	2					9
Oct-18	1	2	1	**0**	3	4	7	4	5					27
Oct-19	1	7	**0**	13	14	8	13	5	6					67

Appendix 1-5. Actual counts of sockeye salmon at Stamp Falls Fishway, 1991. Bold numbers that are underlined indicate when verification tests were conducted.

	Hour of Day													
Date	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	Total
Oct-20	2	6	11	10	8	9	**5**	8	5					64
Oct-21	2	2	4	6	9	**3**	9	9	6					50
Oct-22	0	1	3	2	6	**2**	3	4	10					31
Oct-23	1	0	3	6	3	**1**	3	6	4					27
Oct-24	0	1	0	1	3	4	**4**	7	4					24
Oct-25	0	0	1	1	**0**	0	1	2	2					7
Oct-26	0	0	0	0	0	0	0	0	0					0
Oct-27	0	0	0	0	0	0	0	0						0
Oct-28	0	0	0	0	0	0	0							0
Oct-29	0	0	0	0	0	0	0	0						0
Oct-30	0	1	0	0	0	0	1	0						2
Oct-31	0	0	0	0	0	0	0	0						0
Nov-01	0	1	3	4	0	1	0	1						10
Nov-02	0	0	0	0	0	2	0	0						2
Nov-03	2	0	0	0	0	0	1							3
Nov-04	0	3	3	2	8	1	6	1						24
Nov-05	6	9	20	14	16	16	11							92
Nov-06	1	1	4	1	0	7	5							19
Nov-07	1	0	1	0	5	5	8							20
Nov-08	5	10	21	28	26	28	17							135
Nov-09	6	21	15	24	9	14	3							92
Nov-10	0	2	7	3	1	0	8							21
TOTAL	1708	1988	1356	1388	1027	843	912	751	910	576	69	51	9	11588

Appendix 2-1. Dead recovery and adipose-clipped status of chinook salmon recovered in the Stamp River, by location, 1991.

	Location 1						Location 2					
	Total recovered			Adipose clipped			Total recovered			Adipose clipped		
Date	M	F	J	M	F	J	M	F	J	M	F	J
Oct-07	31	40	10	1	3	0	10	21	1	1	0	0
Oct-08	11	17	4	0	1	0	15	18	2	0	1	0
Oct-09	0	0	0	0	0	0	0	0	0	0	0	0
Oct-10	34	36	8	1	1	0	13	21	3	0	2	0
Oct-11	23	45	12	0	5	0	7	16	11	0	0	0
Oct-12	0	0	0	0	0	0	0	0	0	0	0	0
Oct-13	0	0	0	0	0	0	0	0	0	0	0	0
Oct-14	24	26	0	0	0	0	109	176	37	5	10	0
Oct-15	62	100	30	1	6	4	38	38	10	1	2	0
Oct-16	15	33	11	0	0	0	0	0	0	0	0	0
Oct-17	129	289	114	3	17	2	0	0	0	0	0	0
Oct-18	123	185	85	7	7	2	0	0	0	0	0	0
Oct-19	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	151	202	83	7	21	5	32	36	18	5	3	0
Oct-21	138	192	121	2	10	6	0	1	0	0	0	0
Oct-22	138	222	113	1	7	3	0	0	0	0	0	0
Oct-23	0	0	0	0	0	0	0	0	0	0	0	0
Oct-24	67	148	35	2	3	1	0	0	0	0	0	0
Oct-25	79	159	51	4	7	3	0	0	0	0	0	0
Oct-26	0	0	0	0	0	0	0	0	0	0	0	0
Oct-27	44	85	43	2	4	0	0	0	0	0	0	0
Oct-28	56	118	86	2	4	2	0	0	0	0	0	0
Oct-29	67	323	157	0	9	4	0	0	0	0	0	0
Oct-30	87	274	145	5	6	10	8	21	21	1	1	0
Oct-31	48	148	145	4	6	3	46	123	84	2	7	4
Nov-01	87	208	195	1	5	9	0	0	0	0	0	0
Nov-02	0	0	0	0	0	0	0	0	0	0	0	0
Nov-03	0	0	0	0	0	0	0	0	0	0	0	0
Nov-04	39	153	104	5	6	2	0	0	0	0	0	0
Nov-05	34	93	72	1	4	3	23	37	18	2	0	0
Nov-06	108	315	166	5	15	3	0	0	0	0	0	0
Total	1595	3411	1790	54	147	62	301	508	205	17	26	4

Abbreviations are: M = male, F = female, J = jack

Appendix 2-1 (cont.). Dead recovery and adipose-clipped status of chinook salmon recovered in the Stamp River, by location, 1991.

	Location 3						Location 4					
	Total recovered			Adipose clipped			Total recovered			Adipose clipped		
Date	M	F	J	M	F	J	M	F	J	M	F	J
Oct-07	19	31	6	2	2	2	0	0	0	0	0	0
Oct-08	4	8	0	0	0	0	0	7	2	0	1	0
Oct-09	0	0	0	0	0	0	0	0	0	0	0	0
Oct-10	7	12	0	1	0	0	8	9	5	0	0	0
Oct-11	9	16	5	0	2	0	4	9	2	0	0	0
Oct-12	0	0	0	0	0	0	0	0	0	0	0	0
Oct-13	0	0	0	0	0	0	0	0	0	0	0	0
Oct-14	0	0	0	0	0	0	0	0	0	0	0	0
Oct-15	45	105	31	1	2	0	21	32	9	3	2	0
Oct-16	0	0	0	0	0	0	0	0	0	0	0	0
Oct-17	68	103	40	3	6	2	7	18	14	0	0	0
Oct-18	0	0	0	0	0	0	0	0	0	0	0	0
Oct-19	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0	0	0	0
Oct-21	67	185	49	2	4	0	11	17	4	2	1	1
Oct-22	129	232	67	3	6	5	0	0	0	0	0	0
Oct-23	0	0	0	0	0	0	0	0	0	0	0	0
Oct-24	74	235	68	2	6	2	0	0	0	0	0	0
Oct-25	122	244	68	9	11	2	0	0	0	0	0	0
Oct-26	0	0	0	0	0	0	0	0	0	0	0	0
Oct-27	0	0	0	0	0	0	0	0	0	0	0	0
Oct-28	38	183	74	3	8	5	0	0	0	0	0	0
Oct-29	72	253	132	1	6	4	0	0	0	0	0	0
Oct-30	67	209	138	6	8	1	0	0	0	0	0	0
Oct-31	0	0	0	0	0	0	0	0	0	0	0	0
Nov-01	54	201	147	2	10	3	0	0	0	0	0	0
Nov-02	0	0	0	0	0	0	0	0	0	0	0	0
Nov-03	0	0	0	0	0	0	0	0	0	0	0	0
Nov-04	62	208	123	3	8	2	0	0	0	0	0	0
Nov-05	0	0	0	0	0	0	0	0	0	0	0	0
Nov-06	47	175	83	3	7	3	0	0	0	0	0	0
Total	884	2400	1031	41	86	31	51	92	36	5	4	1

Abbreviations are: M = male, F = female, J = jack

Appendix 2-1 (cont.). Dead recovery and adipose-clipped status of chinook salmon recovered in the Stamp River, by location, 1991.

	Location 5						Location 6					
	Total recovered			Adipose clipped			Total recovered			Adipose clipped		
Date	M	F	J	M	F	J	M	F	J	M	F	J
Oct-07	0	0	0	0	0	0	0	0	0	0	0	0
Oct-08	11	17	1	1	0	0	0	0	0	0	0	0
Oct-09	0	0	0	0	0	0	0	0	0	0	0	0
Oct-10	8	5	4	1	0	0	0	0	0	0	0	0
Oct-11	2	2	2	0	0	0	0	0	0	0	0	0
Oct-12	0	0	0	0	0	0	0	0	0	0	0	0
Oct-13	0	0	0	0	0	0	0	0	0	0	0	0
Oct-14	0	0	0	0	0	0	0	0	0	0	0	0
Oct-15	5	11	4	0	0	1	0	0	0	0	0	0
Oct-16	0	0	0	0	0	0	0	0	0	0	0	0
Oct-17	0	0	0	0	0	0	0	0	0	0	0	0
Oct-18	0	0	0	0	0	0	0	0	0	0	0	0
Oct-19	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0	0	0	0
Oct-22	0	0	0	0	0	0	0	0	0	0	0	0
Oct-23	0	0	0	0	0	0	0	0	0	0	0	0
Oct-24	0	0	0	0	0	0	0	0	0	0	0	0
Oct-25	0	0	0	0	0	0	0	0	0	0	0	0
Oct-26	0	0	0	0	0	0	0	0	0	0	0	0
Oct-27	0	0	0	0	0	0	0	0	0	0	0	0
Oct-28	0	0	0	0	0	0	0	0	0	0	0	0
Oct-29	0	0	0	0	0	0	0	0	0	0	0	0
Oct-30	0	0	0	0	0	0	0	0	0	0	0	0
Oct-31	0	0	0	0	0	0	0	0	0	0	0	0
Nov-01	0	0	0	0	0	0	0	0	0	0	0	0
Nov-02	0	0	0	0	0	0	0	0	0	0	0	0
Nov-03	0	0	0	0	0	0	0	0	0	0	0	0
Nov-04	0	0	0	0	0	0	0	0	0	0	0	0
Nov-05	0	0	0	0	0	0	0	0	0	0	0	0
Nov-06	0	0	0	0	0	0	0	0	0	0	0	0
Total	26	35	11	2	0	1	0	0	0	0	0	0

Abbreviations are: M = male, F = female, J = jack

Appendix 2-1 (cont.). Dead recovery and adipose-clipped status of chinook salmon recovered in the Stamp River, by location, 1991.

	Location 7						Location 8					
	Total recovered			Adipose clipped			Total recovered			Adipose clipped		
Date	M	F	J	M	F	J	M	F	J	M	F	J
Oct-07	0	0	0	0	0	0	0	0	0	0	0	0
Oct-08	0	0	0	0	0	0	0	0	0	0	0	0
Oct-09	0	0	0	0	0	0	0	0	0	0	0	0
Oct-10	0	0	0	0	0	0	0	0	0	0	0	0
Oct-11	0	0	0	0	0	0	0	0	0	0	0	0
Oct-12	0	0	0	0	0	0	0	0	0	0	0	0
Oct-13	0	0	0	0	0	0	0	0	0	0	0	0
Oct-14	0	0	0	0	0	0	0	0	0	0	0	0
Oct-15	0	0	0	0	0	0	0	0	0	0	0	0
Oct-16	0	0	0	0	0	0	0	0	0	0	0	0
Oct-17	0	0	0	0	0	0	0	0	0	0	0	0
Oct-18	0	0	0	0	0	0	0	0	0	0	0	0
Oct-19	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	0	0	0	0	0	0
Oct-22	0	0	0	0	0	0	0	0	0	0	0	0
Oct-23	0	0	0	0	0	0	0	0	0	0	0	0
Oct-24	0	0	0	0	0	0	0	0	0	0	0	0
Oct-25	0	0	0	0	0	0	0	0	0	0	0	0
Oct-26	0	0	0	0	0	0	0	0	0	0	0	0
Oct-27	0	0	0	0	0	0	0	0	0	0	0	0
Oct-28	0	0	0	0	0	0	0	0	0	0	0	0
Oct-29	0	0	0	0	0	0	0	0	0	0	0	0
Oct-30	0	0	0	0	0	0	0	0	0	0	0	0
Oct-31	0	0	0	0	0	0	0	0	0	0	0	0
Nov-01	0	0	0	0	0	0	0	0	0	0	0	0
Nov-02	0	0	0	0	0	0	0	0	0	0	0	0
Nov-03	0	0	0	0	0	0	0	0	0	0	0	0
Nov-04	0	0	0	0	0	0	0	0	0	0	0	0
Nov-05	0	0	0	0	0	0	0	0	0	0	0	0
Nov-06	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0

Abbreviations are: M = male, F = female, J = jack

Appendix 2-1 (cont.). Dead recovery and adipose-clipped status of chinook salmon recovered in the Stamp River, by location, 1991.

	Location 9						Location 10					
	Total recovered			Adipose clipped			Total recovered			Adipose clipped		
Date	M	F	J	M	F	J	M	F	J	M	F	J
Oct-07	0	0	0	0	0	0	0	0	0	0	0	0
Oct-08	0	0	0	0	0	0	0	0	0	0	0	0
Oct-09	0	0	0	0	0	0	0	0	0	0	0	0
Oct-10	25	40	7	1	2	0	0	0	0	0	0	0
Oct-11	0	0	0	0	0	0	11	11	9	0	0	0
Oct-12	0	0	0	0	0	0	0	0	0	0	0	0
Oct-13	0	0	0	0	0	0	0	0	0	0	0	0
Oct-14	0	0	0	0	0	0	0	0	0	0	0	0
Oct-15	0	0	0	0	0	0	15	18	9	0	0	0
Oct-16	74	133	34	6	6	4	0	0	0	0	0	0
Oct-17	0	0	0	0	0	0	0	0	0	0	0	0
Oct-18	0	0	0	0	0	0	0	0	0	0	0	0
Oct-19	0	0	0	0	0	0	0	0	0	0	0	0
Oct-20	0	0	0	0	0	0	0	0	0	0	0	0
Oct-21	0	0	0	0	0	0	53	69	44	2	1	1
Oct-22	0	0	0	0	0	0	61	82	53	3	5	3
Oct-23	98	201	41	7	6	1	35	27	13	1	1	0
Oct-24	0	0	0	0	0	0	140	177	96	4	6	7
Oct-25	0	0	0	0	0	0	107	163	119	6	7	6
Oct-26	13	34	4	1	0	0	86	116	82	1	4	1
Oct-27	0	0	0	0	0	0	112	173	139	2	6	4
Oct-28	0	0	0	0	0	0	73	115	115	4	4	2
Oct-29	0	0	0	0	0	0	58	106	126	2	4	3
Oct-30	0	0	0	0	0	0	38	116	162	1	3	5
Oct-31	0	0	0	0	0	0	52	128	152	3	4	4
Nov-01	0	0	0	0	0	0	35	80	97	2	2	2
Nov-02	0	0	0	0	0	0	0	0	0	0	0	0
Nov-03	0	0	0	0	0	0	0	0	0	0	0	0
Nov-04	0	0	0	0	0	0	74	191	219	4	6	4
Nov-05	0	0	0	0	0	0	29	56	123	2	1	1
Nov-06	0	0	0	0	0	0	22	44	67	0	1	3
Total	210	408	86	15	14	5	1001	1672	1625	37	55	46

Abbreviations are: M = male, F = female, J = jack

Appendix 2-2. Total chinook and adipose-clip returns to Robertson Creek Hatchery, 1991.

Date	Total returns (a)			Adipose clips (a)		
	M	F	J	M	F	J
230991	0	0	2	0	0	2
240991	0	0	0	0	0	0
250991	0	0	8	0	0	8
270991	0	0	0	0	0	0
031091	0	0	0	0	0	0
041091	0	0	4	0	0	4
051091	11	0	12	11	0	12
061091	0	1	0	0	1	0
071091	47	3	7	47	3	7
081091	29	3	7	29	3	7
091091	52	10	6	52	10	6
101091	85	19	18	85	19	18
111091	79	21	8	79	21	8
121091	49	67	7	49	67	7
131091	42	90	7	42	90	7
141091	43	98	6	43	98	6
151091	61	12	8	61	12	8
161091	31	27	8	31	27	8
171091	24	11	4	24	11	4
181091	17	8	2	17	8	2
191091	0	0	0	0	0	0
201091	11	1	1	11	1	1
211091	26	6	1	26	6	1
221091	22	2	0	22	2	0
231091	66	18	7	66	18	7
241091	15	5	8	15	5	8
251091	15	4	5	15	4	5
261091	26	26	6	26	26	6
271091	0	0	0	0	0	0
281091	21	8	3	21	8	3
291091	8	4	2	8	4	2
301091	4	2	4	4	2	4
311091	16	9	5	16	9	5
011191	0	0	0	0	0	0
021191	0	0	0	0	0	0
031191	0	0	0	0	0	0
041191	3	1	1	3	1	1
051191	0	0	0	0	0	0
061191	0	0	0	0	0	0
071191	0	0	0	0	0	0
081191	0	2	1	0	2	1
091191	0	0	0	0	0	0
101191	0	0	0	0	0	0
111191	0	0	0	0	0	0

Appendix 2-2. Total chinook and adipose-clip returns to Robertson Creek Hatchery, 1991.

Date	Total returns (a)			Adipose clips (a)		
	M	F	J	M	F	J
121191	0	0	0	0	0	0
131191	0	0	0	0	0	0
141191	0	0	0	0	0	0
151191	0	0	0	0	0	0
161191	0	0	0	0	0	0
171191	0	0	0	0	0	0
181191	0	0	0	0	0	0
191191	0	0	0	0	0	0
201191	0	0	0	0	0	0
211191	0	0	0	0	0	0
Total	803	458	158	803	458	158
Adjustment (b)				30	-156	32
Adjusted total				833	302	190

(a) Abbreviations are: M = male, F = female, J = jack

(b) The total number of fish observed and counted was adjusted post-season to account for actual heads taken and decoded. An additional 30 adult male and 32 jack heads were included. The count of females was adjusted down by 156 to match actual heads taken. It is not known why the discrepancy between heads taken and fish counted occurred.